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MANAGEMENT AND ADMINISTRATION IN

# MANUFACTURING INDUSTRIES

L. P. Alford, *Editor* George E. Hagemann, *Associate Editor*

Vol. XI CONTENTS FOR JANUARY, 1926 No. 1


| | | PAGE |
|---|---|---|
| A Program for 1926 | | 5 |
| The Modern Manufacturing Plant | Harold Ashworth | 7 |
| Hand Labor and Machinery as Producers | Rhodes Polleys | 11 |
| General Electric Group Insurance | | 12 |
| How the Bakelite Corporation Effectively Manages Organized Research | A. V. H. Mory and Leon V. Quigley | 13 |
| Scope of Financial and Industrial Investigations | Arthur Andersen | 17 |
| Coal Handling and Boiler Operation at Northern Paper Mills | H. W. Gochnauer | 23 |
| Relation of Safety and Production | Robert H. Luckenbach | 25 |
| "Please Clean This Car" | | 28 |
| Budgeting the Textile Industry | Carey E. Tharp | 29 |
| Handling Products in the Squibb Plant | George E. Hagemann | 35 |
| An Effective Production Control System | John J. Swan | 39 |
| Simplified Practice Progress | | 43 |
| A Neglected Phase of Cost Accounting | J. W. Robinson | 44 |
| Management in Lumber Dry Kilns | Thomas D. Perry | 45 |
| A Fence Made from Scrap | H. G. Edwards | 50 |
| What Management Has Done for Us | U. L. Harmon | 51 |
| Keeping Down the Cost of the Factory Dispensary | M. S. Rossy | 55 |
| Current Information Index | | 56 |
| Index to Advertisers | | 68 |


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Rutledge Bermingham, Advertising Manager L. K. Henderson, Circulation Manager

Published monthly by THE RONALD PRESS COMPANY; Philip J. Warner, President and Treasurer; William J. Grange, Secretary. All Correspondence with the publishers should be addressed to the Editorial and Business Offices, 15 East 26th Street, New York. Notice of Change of Address must be received not later than the 10th of the month preceding date of issue with which it is to go into effect. Copies cannot be supplied to replace any not received due to failure to send in notification regarding change of address. Publishers cannot undertake to supply missing issues more than one month after publication. Terms. Annual subscription, five dollars. Single issues, fifty cents each.

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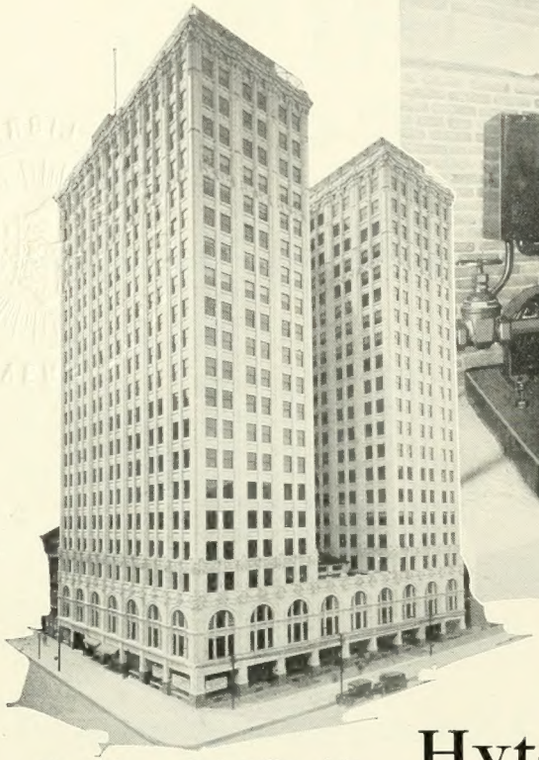
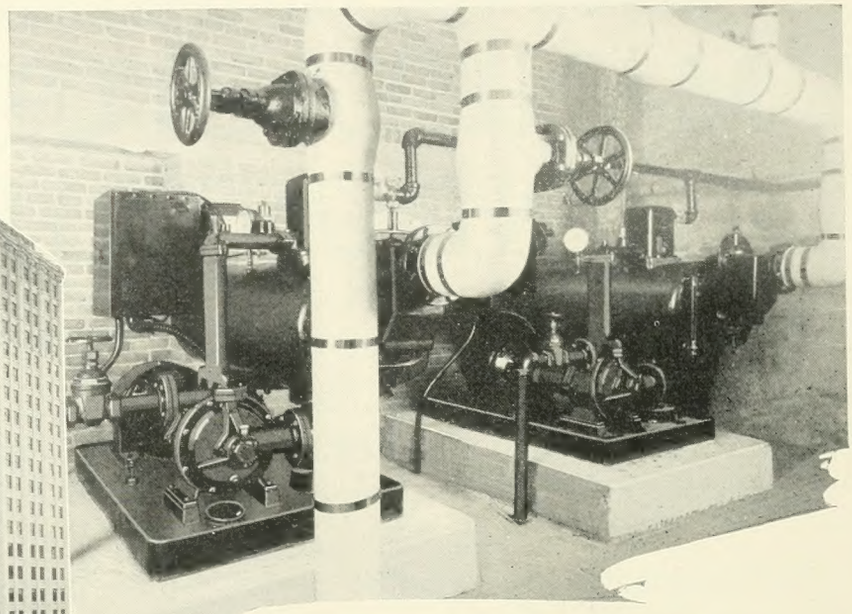


*This is the new Bank Building of the Brotherhood of Locomotive Engineers, Cleveland, Ohio. Mr. R. G. Nairn, Engineer of Construction, Cleveland, Ohio.*



*Two motor-driven Jennings Hytor Vacuum Pumps with automatic control, installed in the new B. of L. E. Bank Building, Cleveland, Ohio. These units serve 92,000 sq. ft. equivalent direct radiation.*

# Hytors—a logical choice for this up-to-date plant

Starting in 1920 with modest quarters, the labor bank of the Brotherhood of Locomotive Engineers, Cleveland, grew so rapidly that by 1925 larger facilities became necessary. As a result, the new 19-floor bank and office building, shown at left, was planned and built.

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# Jennings Hytor

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MANAGEMENT AND ADMINISTRATION IN
MANUFACTURING INDUSTRIES

VOLUME XI JANUARY, 1926 NUMBER 1

# A Program for 1926

WITH this first issue of 1926, which marks the sixth year of this journal, we are glad to call attention to improvements in nearly every feature of the publication.

In appearance you will note many changes. A more pleasing cover has been adopted, in which the display of the title has been modified to bring out more clearly the field of the journal. The page size has been made larger, permitting an increase in size of type, wider illustrations, less crowding of items in the tables—in short resulting in a printed page warm and inviting in appearance. A still higher quality of paper has been used, and numerous details of arrangement have been improved.

It is hoped that these modifications will all make the magazine still more useful and usable to its subscribers and readers. It is our aim to have a publication of quality up to the highest standards of those who are giving it such cordial support.

### Purpose and Objective

Likewise in subject matter the issues of 1926 will surpass the efforts of any preceding year. For those new readers who are not so familiar with the magazine we are glad to take this opportunity of stating something of its purpose and objective.

This publication is a monthly journal for men who operate manufacturing businesses to make them pay. It is devoted to deserved profit-making as the result of the successful carrying on of every activity in manufacturing industry. Its pages deal with ways and means to secure a maximum economic output of plant production, to foster and maintain harmonious industrial relations and high employee morale, to obtain low manufacturing and distribution costs, to determine and put into effect master programs stretching over a period of years, and as a result to realize month by month and year by year a high level of continuous profit.

Thus the journal is for men who are responsible for getting work done. Every issue gives practical information, useful facts, organized data—the mature experience of the managers and executives of successful concerns. Ninety per cent of the articles printed are the personal contributions of men who are leaders in the positions they occupy. What they write is reliable and authoritative.

### Actual Cases and Proved Results

Much of the material consists of actual cases and proved results. There is little discussion of generalities or principles, unless they are associated with some concrete application showing their value and worth.

In carrying out the editorial program during 1926 an effort will be put forth to cover all essential problems of profitable manufacturing under present day conditions of keen competition. The all-round viewpoint will be taken of every manufacturing problem. Thus the major lines of executive effort will be presented in a co-ordinated way—the effect of marketing on production, of production on finance, and of all three on earnings and profit.

To indicate some of the material which will be presented in carrying out this editorial purpose and program ten topics are briefly outlined as representative. By no means do they cover all, or even a major part, of the information which will be presented in these pages during 1926. But they not only show the source and quality of articles and discussions to be offered here; they also will suggest to readers their lines of planning and progress for the new year.

### Ten Vital Topics

*Financial Management.*—Since 1922, management has produced a new tool, the financial budget. It is hoped that every reader will try to get his business on a budget basis in 1926, as the soundness of the method is unquestionable. More information on its

establishment, organization of personnel for its administration and its results in manufacturing concerns has appeared in the pages of this journal than in all others put together. This enviable record we purpose to maintain.

*Industrial Investigation.*—Another tremendous advance has been in methods of organizing and drawing conclusions from operating and financial facts. One of the outstanding figures in this development is Arthur Andersen, of Arthur Andersen and Company, who with his associates has applied ingenious methods with marked success to both large and small manufacturing concerns. A group of articles, of which one is in this issue, is the first disclosure of this procedure which promises to take at once a deserved place in modern management.

*Where and Why to Locate a Plant.*—Too often the selection of a manufacturing site is thought of as something that is done but once in a lifetime and is so exceptional a business act as to demand no attention until a specific need arises. From now on conditions will force this method to be abandoned for long range planning which will consider where a particular industry or plant should be located 5, 10 or even 20 years hence. We are pleased to announce that Harrison S. Colburn, who has negotiated many of the largest and most carefully studied transactions of industrial property along the Atlantic seaboard, will treat this topic extensively during the year 1926 in the pages of this journal.

*Modern Manufacturing Buildings.*—The advance in industrial building design and construction since 1919 has been so great as to be almost revolutionary. The same situation exists as regards fixed manufacturing equipment. To open these advances in the "greatest tool of production" to the subscribers to this magazine a group of articles was planned and publication begun in September, 1925. This monthly feature will be continued throughout 1926. The article in this issue is by Harold Ashworth, Engineer of Plants, Atwater Kent Manufacturing Company.

*Production Control.*—Production control is still a wonder worker though it was the first application of management. Almost unbelievable increases in output, reductions in cost, improvements in quality and maintenance of shipping schedules are being made. Developments and records of this kind will be in every issue drawn from the most progressive manufacturing establishments. A representative article of this kind is the one by John J. Swan in this issue.

*Material Handling.*—During the year 1926 immensely valuable experience will be acquired in the operation of material handling equipment. Thus the demand for information on performance will have especial attention for the time has come for the application of better management to the operation of such equipment, in order that costs may be reduced and a basis had for further improvement. During 1926 this magazine will present, for the first time, articles on bonus plans for material handling, machine-hour rates for conveying equipment, analyzed costs for handling material, relationship of material handling to processing, and on other equally significant topics. This part of our editorial schedule is under the direction of George E. Hagemann, Associate Editor, who is a member of the executive committee of the Materials Handling Division of the American Society of Mechanical Engineers.

*Low Cost Power Production.*—The present editorial policy of including one article each month on efficient power production, transmission and application will be continued. Power management deserves to be upgraded, with improvement in the operating personnel and methods of control. The performance of all equipment more than five years old should be investigated to determine if repairs, changes or replacement would not earn a handsome return on the additional investment. All these questions are scheduled for discussion in these pages during 1926. H. W. Gochnauer, Plant Engineer, Northern Paper Mills, takes up coal handling in this number.

*The Working Force.*—An enormous number of printed pages has been and is being devoted to the relations between employers and employees. This kind of material is easily written and as easily thrown away. But here and there important work is being done to stabilize the working force. Such worthy developments will be presented. Safety and accident prevention, which promises to receive new attention in 1926, will be in the forefront of this part of the schedule. The article by Robert L. Luckenbach, Safety Engineer, Edward G. Budd Manufacturing Company, in this issue is an example.

*Marketing Management.*—There is no question but that in 1926 marketing must be fully co-ordinate with production and finance as a management responsibility. The new, scientific approach to this part of the work of the manufacturer will be presented throughout this year. Methods will be explained to keep production and sales in step, to increase profits by expanding markets and volume of sales, to set fair selling prices, and to realize anticipated profits on the amount of business done. For example, W. L. Churchill will in February follow further the ideas in his discussion, in a previous issue, of "Dangerous Selling Prices," which caused so much comment.

*The Management Program.*—There is evidence that manufacturing management will take a great forward step in 1926, the like of which has occurred only three or four times in its history. Intensive work and all embracing planning now being done in several large industries are the reason for this belief. This work is being studied to determine just when and how it can be made available to the readers of this journal. It is confidently expected that some interesting disclosures will be made during the year.

All this material and more will be presented in these pages with the hope and purpose that MANUFACTURING INDUSTRIES may be of direct and definite help in successful manufacturing operation during 1926.

# The Modern Manufacturing Plant

## Atwater Kent Company has World's Largest Radio Factory, a Single Story Building with 15 Acres Under Glass

By HAROLD ASHWORTH

*Superintendent of Plants, Atwater Kent Manufacturing Company*

A FEW years ago the Atwater Kent Manufacturing Company began to forge ahead in the radio field at a phenomenal rate. The manufacture of automotive ignition equipment and other accessories, formerly the major output of the company, was soon overshadowed by the very rapid development of its radio department.

With a sudden growth in business actually upon it, and a future growth of unknown potentialities ahead, the company was face to face with the problem of expanding its manufacturing facilities in such a way as to take care of the actual business in hand, while at the same time allowing for further growth of unknown dimensions. It was apparent that continued growth would involve constant enlargement of departments, so that flexibility was an essential characteristic of any new plant. At the start, when radio was a popular fad of doubtful duration, it seemed wise to make any new plant readily convertible to other uses, should the demand for radio equipment vanish with the Aladdin-like speed at which it had arrived.

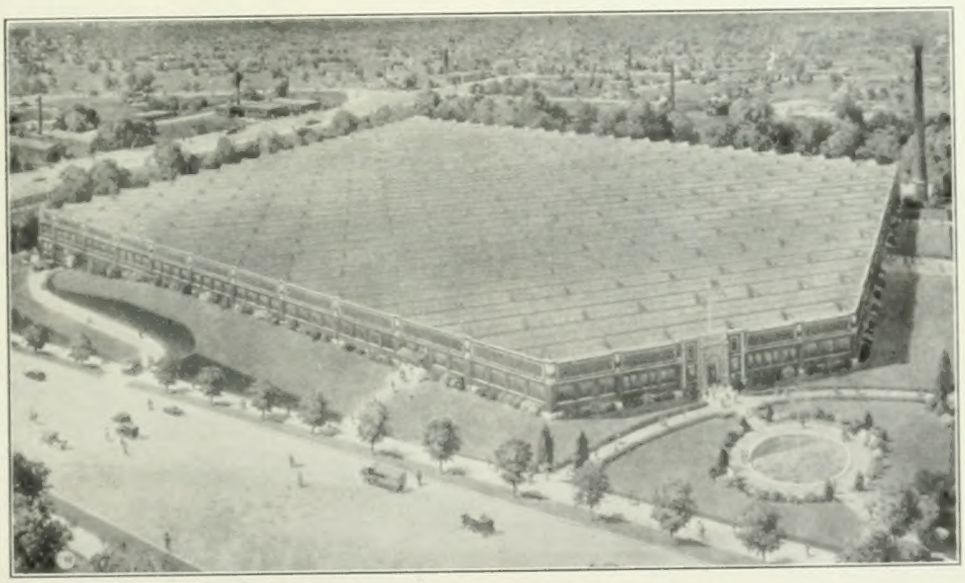


FIG. 1 NEW ATWATER KENT PLANT COVERS 15 ACRES

All of these factors led the company to the purchase of a large tract of land opposite Fern Hill Park in the lower part of Germantown, Philadelphia, within a single fare and 25 minutes trolley ride of the City Hall, as the site for a plant of indefinite size. The property included something over 20 acres, all told, and was fairly level over the main part, though sloping sharply on two sides so that the maximum difference in grade was about 30 ft. The plant built upon this land has successfully met the unusual conditions that the circumstances imposed.

The plant, Fig. 1, as it stood until recently, was built in three sections and contained a total floor area of 492,450 sq. ft. or approximately 11½ acres. A fourth unit adjoining the main building, but at lower grade, is now under construction. This building will add 150,000 sq. ft. of floor space, bringing the total to 642,450 sq. ft., or about 15 acres.

The first unit, or western section, triangular in shape and consisting of 65,892 sq. ft., was completed in 1923. Almost immediately after it was put to use, the continued growth of business necessitated the erection of the central section of 267,800 sq. ft. This in turn was quickly followed by the eastern section of 158,750 sq. ft., completed in the first part of 1925. The new unit, to be in the right background of Fig. 1, will be ready in the spring of 1926.

The entire plant is one story in height, except that where the slope of the ground permits, basement space has been provided. The first, or main, floor of both the completed and the new units is of special sawtooth construction, providing natural lighting probably unsurpassed by any manufacturing plant in the country.

The first feature that impresses the new visitor is the architectural excellence of the exterior and the attractive development of the grounds with plantings of trees and shrubbery, and finely kept lawns.

The entrance, the dominant architectural feature of the building, is of limestone colored terra cotta in Renaissance design, with heavy columns on each side of an arched doorway. The walls of the plant are of dark red rough-textured brick with terra cotta ornament and trim. The walls are carried up above the

windows to form a parapet which conceals the saw-tooth skylights, and this area is ornamented by having the brick set in a simple diagonal pattern.

Aside from the attractive lobby with its tile floor, paneled plaster walls, fireplaces and ornament of the Georgian period, and the beautiful private office suite of the president, the next features that leave lasting impressions are the enormous size of the plant, its superb lighting, and its very wide column spacings.

The main plant has a frontage of 736 ft. on Wissahickon Avenue, 456 ft. on Abbottsford Road, 600 ft. on Deacon Street and 736 ft. on a private driveway. The new unit under construction has a frontage of 225 ft. on Roberts Avenue, 198 ft. on King Street and a depth of 514 ft. When one realizes that a person can seldom be recognized at a distance of much over 250 ft., the impression of limitless extent can be imagined when one enters the main section and looks 600 ft. or more down the building to the far walls.

FIG. 2 EXCELLENT DAYLIGHT, CLEANLINESS AND WIDE SPACING OF COLUMNS ARE IMPORTANT FEATURES

Within the plant one gets the impression of being out-of-doors, the light is so perfect. See Fig. 2. By actual test, the impression of least light occurs when one approaches to within about 6 ft. of the northerly wall windows. This effect is due to the fact that the area of glass in the saw-tooth skylights is more than one-third the area of the floor beneath. The skylights face due north, a feature accomplished by placing them diagonally across the building, thereby excluding the direct rays of the sun with its attendant glare and heat, and admitting only the light reflected from the north sky.

The skylight sash is glazed with clear glass, and the under side of the roof slabs, the walls, columns and structural members, are painted white to assist in the diffusion of the light. Even the roof is coated with specially selected light colored pebbles to reflect light into the adjacent skylights. The building is absolutely free from shadows, providing abundant soft light in every part to aid the operatives in the fine work required by the company's product.

The spacing of the columns supporting the roof likewise arouses comment. In the original or western section the columns are spaced at intervals of 40 by 80 ft. In the sections constructed later the columns are spaced 40 by 40 ft. These wide spans were made possible by the adoption of the patented Ballinger "Super-Span" type of saw-tooth construction. This embodies the formation of a simple truss using structural members of the saw-tooth skylights themselves. The upper members of the skylights are joined together at intervals by a horizontal beam extending from peak to peak above the roof. Where the spans are 80 ft., four skylights are thus joined together to form the truss. Where the columns are but 40 ft. apart, only two skylights comprise each truss. This system also employs light trusses directly in back of the glass in conjunction with the main trusses joining the skylights. It is a very economical method of procuring free and unobstructed floor areas. Its use in this plant has made possible the expansion and often the complete interchange of departments without any loss of effective floor area due to the varying space requirements of the equipment used in each process.

In ordinary saw-tooth construction there is a row of columns under each skylight. The columns are generally spaced from 16 to 25 ft. in each row. Since in this plant the individual skylights are 20 ft. wide, the use of ordinary construction would have required a spacing 20 by 20 ft., or 400 sq. ft. to a column. The adopted span of 40 by 40 ft. for the major part of the plant gives a floor area of 1600 sq. ft. per column, and in the western section there is an area of 3200 sq. ft. per column. This indicates the benefits in flexibility and space economy with this special type of roof.

The roof is of gypsum cast in place and supported by steel purlins. The upper surface is a four-ply tarred felt and pebble built-up roofing with copper flashings. The columns are of steel fireproofed to the lower chord of the trusses with concrete.

The floor is of maple laid on 2-in. plank and yellow pine sleepers over a concrete structural floor, except in the basement where concrete alone is used.

Interior partitions surrounding the carpenter and cabinet shops, the sand blast room, the oven room (where the speaker horns and other metal parts are enameled and baked), the toilets, and other special areas, are of both brick and hollow tile. All interior surfaces are painted with mill white paint above a dado of khaki color to minimize staining.

The side wall windows are of rolled steel sash with ventilating sections individually hand-operated. They are glazed with clear glass in the lower units, while the two upper lights are glazed with actinic glass to reduce sun glare. The skylights are all of clear glass and have ventilating sections about 120 ft. long, manually operated by chains hanging within easy reach.

The interior doors are mostly of wood, except where

fire doors are required leading to some of the special departments. These doors are tin-clad. There are electrically-operated rolling steel shutters enclosing the truck slips.

There is one freight elevator of 6000 lb. capacity running from the basement to the ground floor, and operated by electricity at a speed of 50 ft. per min. when fully loaded. The enclosures are of steel, formed of solid steel plates in the lower half and wire mesh grilles above. The doors are two section lift up gates of similar materials.

The entire plant is fully sprinklered with a wet-pipe system connected to the city supply and to an auxiliary fire pump of 1500 gal. per min. capacity, fed by an outside steel reservoir holding 150,000 gal. of water.

The heating system is interesting because of the wide use of unit heaters. Steam coils are enclosed in a casing through which air is circulated by means of powerful but silent electric fans. The air passes out through horizontal ducts at the top, the vents being arranged to direct the air uniformly around the heater in a plane about eight ft. above the floor. The unit heaters are individually automatically controlled by thermostats employing the Johnson system of tem-

Fig. 2 Belt Conveyor for Assembling Radio Sets

perature control. There is some direct radiation in the offices, toilets and special workrooms. A vacuum system is employed throughout.

Steam is generated by a battery of two 150-hp. boilers and two 500-hp. boilers. One new 500-hp. unit is being installed. All boilers burn oil, and a complete Peabody oil burning and storage system has been installed. There is a single radial brick stack 175 ft. high, having a top inside diameter of 8 ft.

Electric current is supplied by the Philadelphia Electric Company at 13,000 volts to a main substation of 1666 kva., which reduces the voltage to 2300, and distributes current within the plant to 3 substations of 400 kva. capacity, each transforming from 2300 volts, 2-phase to 230-115 volts, 2-phase.

The artificial lighting is provided by direct ceiling fixtures placed just below the lower chord of the saw-tooth skylights. Steel reflectors containing 300- to 500-watt lamps are spaced on 20 ft. centers, providing illumination of 6 to 12 ft.-candles intensity at the working plane.

Considerable attention has been given to the provision of adequate and modern toilet and wash rooms and women's rest rooms. Wash basins are provided in batteries 16 ft. long, eight basins to a side. There is also a complete emergency hospital and dispensary within the building. Drinking fountains are installed at regular intervals throughout the plant.

Many hydraulic presses are required for bakelite moulding. These are served by high-pressure, electrically-driven pumps located in the power house, supplying working pressures around 3000 lb. per sq. in. There is also a low pressure system operating at about 225 lb. per sq. in.

A description of the process equipment and its arrangement would require altogether too much space, for many types of machines are employed, many of them designed by Mr. Kent and constructed for his special use. It would also be futile, especially as far as layout is concerned, for it is no uncommon thing for a whole department to be removed to a new location between a Saturday closing hour and Monday morning, while another department is expanded with equal speed to occupy the space thus vacated.

Necessarily, this extraordinary growth has militated against the development of a perfect "straight-line" production arrangement. Nevertheless, a general progression of parts manufacture, sub-assemblies, finished assembly, testing, packing and shipping has been successfully maintained.

In the cabinet department the assembly of the wood cabinets is done in part on a conveyor, and the various steps have been assigned to individual workmen who perform their parts without removing the work from the conveyor.

The main assembly of the sets is done on long benches in the center of which are slow-moving belt conveyors. Operatives sit on both sides of each bench and, after finishing their operations, place the parts on the conveyor. At the head end the first units are put together, and as the panels move down the bench other pieces are added until the completed receiving set is finally delivered to the testing department. See Fig. 3.

The benches are specially designed so that each operative has the proper racks, jigs and tools for the task assigned to her.

Testing is done by comparing the finished set with a standard set permanently mounted on the testing table. Thus variations in transmitting, due to static or other outside causes, do not interfere with testing by actual radio reception. The new set simply must work as well as the standard test set, whatever the season or time of day.

Another conveyor is used in the shipping department to deliver the packed cases directly to the railroad siding. A flat belt conveyor carries the cases several hundred feet outside the building through a sheet metal housing to a special gravity conveyor which drops them down about 30 ft. to the freight platform. This combination of conveyors is due to the difference in grade between the main building and the freight yards which abut upon one side of the property.

A great deal of shipping is done by motor trucks. In rush seasons buyers often send their own trucks from cities hundreds of miles away to get their quota of sets and speakers as fast as they come from the packing room. For the accommodation of these trucks as well as those used for local orders, there are extensive truck slips entirely within the walls of the building. Rolling steel shutters protect the openings. In a similar way, goods received by motor truck come in to truck slips on the opposite side of the building.

Absolute cleanliness and perfect ventilation prevail in this plant at all times. The floors, benches and machines are maintained like between decks on a battleship. The air is kept fresh by the use of the ventilating skylights above described and by the liberal use of hoods or cubicles and exhaust fans for all machines or operations producing dust or fumes.

The general maintenance of the building is also noteworthy. In spite of the enormous area of glass—nearly four acres in the completed units—every pane is washed regularly. The grounds are kept like the gardens of a private estate.

The entire plant was designed and its construction supervised by The Ballinger Company, architects and engineers, of Philadelphia and New York. Construction was performed by Irwin and Leighton, general contractors, except the western section, on which subcontractors were employed directly.

TABLE 1. SUMMARY OF DATA ON ATWATER KENT PLANT

| | |
|---|---|
| Location | Lower Germantown, Philadelphia. Within single fare limit from City Hall. |
| Construction | Steel and brick, fireproof. Exterior has terra cotta trim Floor over basement, flat slab reinforced concrete. Gypsum roof. |
| Grounds | Lawns, well planted on all sides with shrubbery and evergreens. Ornamental pool, flag poles and walks opposite main entrance. Separate grounds for employees' recreation field. |
| Property | Area of plot covered by plant about 20 acres. Recreation field 3 acres. |
| Buildings, size | Manufacturing building: Length 736 ft., width 456 ft. one end and 600 ft. at the other. |
| Architecture, type | One story saw-tooth construction throughout. (Part basement in places, all above ground due to topography.) High parapet wall with ornamental brickwork and stone trim conceals saw-teeth. Main entrance ornamental terra cotta, Renaissance. |
| Neighborhood | Between residential and industrial areas. |
| Employees | 2000 to 3000. Men for heavy work and machine work. Girls employed for assembly, sub-assemblies, etc. |
| Transportation facilities | Sidings from Pennsylvania Railroad. Large truck loading slips and platforms. |
| Entrances | Main entrance to office at truncated corner of building. Employees entrances on Wissahickon Ave. Trucking slips on two streets. |
| Windows | Steel sash, side walls and saw-tooth skylights. |
| Glass | Double-thick Grade A American. Clear in skylights. Clear and actinic in side walls. |
| Doors, exterior | Mostly wood. Fire doors tin-clad. Large truck slips and shipping doors rolling steel shutters with Kinnear unit No. 1 operating mechanism. |
| Doors, interior | Mostly wood. Some heavy partitions have tin-clad doors on wood core. Elevator doors 2-section lift-up gates; lower section steel plate, upper section ¾-in. diamond-mesh screen. Toilet doors wood. |
| Roof | Ballinger "Super-Span" saw-tooth design, permitting long spans between columns. Steel frame construction, gypsum slab poured in place. Surface built-up 4-ply asphalt felt and specially selected white gravel to reflect light into saw-tooth skylights. Skylights placed diagonally across building to get true north orientation. Area of glass in skylights approximately 35 per cent of floor area, giving exceptional natural lighting without glare or shadows. |
| Ventilation | Continuous sections in saw-tooth skylights, operated by hand from floor in units averaging 120 ft. long. Hand-operated ventilating units in steel wall sash. Special ventilators, cyclones, and exhausters in carpenter shop, spraying rooms, etc. |
| Walls, exterior | Brick. Face brick on street facades John T. Brady No. 4 shade (red) rough texture, set in pattern with terra cotta ornament and coping. Terra cotta tooled and colored to match limestone. |
| Walls, interior | Brick, common red. Dado 5 ft. from floor khaki color. Above, painted mill white. |
| Floors, office and lobby | Ornamental tile in pattern. |
| Floors, shop | Basement, cement, granolithic finished, treated with Quickstone integral waterproofing and Ironstone metallic hardener (A. T. Malmed Co.). Rest, maple on yellow pine sleepers laid on concrete structural floor. |
| Ceilings | Underside of saw-tooth skylights, gypsum slab painted mill white. |
| Partitions, office | 4-in. tile, plastered and decorated inside. |
| Partitions, shop | Mostly 9-in. brick, some 4-in. tile, around special departments. |
| Stairs | Concrete with Feralum Universal Improved Perfection safety treads. Pipe rails, 1½-in. galvanized pipe. |
| Lighting | Direct system, mostly ceiling lights. Power from Philadelphia Electric Co. 220-110 volt, 5-wire, 2-phase, for lighting. Basement fixtures mostly Benjamin X5425 on short nipple. Main floor mostly Benjamin X5509 on short nipple. Designed to provide 6 to 12 ft.-candles in manufacturing areas. Spacing approximately 20 by 20 ft. 300 to 500-watt lamps. |
| Heating | Steam generated at 165 lb. pressure and reduced in power-house to working pressure of 5 to 15 lb. Unit heaters of York Heating and Ventilating Co. make employed throughout main plant. Contain coils and electrically driven fans that force air over coils and out at top through vents distributing heated air in a horizontal plane. Units vary in size from 400,000 B.t.u. per hr. to 1,050,000 B.t.u. per hour. Direct radiation in women's washroom, offices, etc., mostly Fowler and Wolfe 10-ft. sections. Unit heaters automatically controlled by Johnson system of temperature control with thermostats placed to insure even distribution. Vacuum system throughout operated by Nash Engineering Co. Jennings Hytor vacuum pumps. |
| Boilers | Two 150-hp. Keeler water tube.<br>Two 500-hp. Keeler water tube.<br>One 500-hp. Casey Hedges water tube now being installed. |
| Fuel | Oil. Peabody system in all boilers. |
| Feed water pumps | Warren Steam Pump Co. |
| Boiler feed regulator | Berry, on 2 large and 2 small boilers. Copes on the new Casey Hedges boiler. |
| Water purification | Boiler feed water from Bethlehem 2-effect evaporator. |
| Feed water heater | Webster. |
| Boiler instruments | General Electric flow meters. |
| Stack | Brick, radial, 175 ft. high, 8 ft. inside diameter at top. |
| Pipe covering | 85 per cent magnesia on expansion bends and main feeders only. |
| Power facilities | One main substation 1666-kva. cap., 13,200-volts 3-phase, to 2300-volts, 2-phase. Four secondary substations, one 666-kva., three of 400-kva. Each from 2300 volts, 2-phase to 230-115 volts, 2-phase. |
| Compressed air | Three Sullivan duplex air compressors delivering 680 cu. ft. per min. direct connected to 120-hp. motors. |
| Water system | City supply. |
| Fire pumps | One 1500-gal. per min. De Laval pump, driven by 150-hp. induction motor, manual control. |
| Motors | Various kinds used throughout plant. |
| Hand trucks | Mostly special racks on castor wheels. |
| Elevator | One freight from basement to first floor, 6000 lb. capacity, 50 ft. per min. travel, traction type, electric. |
| Conveyor systems | Horizontal belt conveyors in assembly departments. Also large belt conveyor from plant to railroad siding delivering cases direct to cars. |
| Dust and fume collectors | Cyclone and separators in cabinet and carpenter shops. Hoods and exhaust fans over many special machines in spray painting and varnishing booths. Also in sand blast department. |
| Sprinklers | Wet pipe system throughout plant. City supply and 150,000 gal. steel reservoir supplying fire pump. |
| Fire alarms | One city box. |
| Watchmen's system | Key stations. |
| Storage shelving | Mostly wood made in shop. Some steel. |
| Storage racks | Largely shop-made to suit needs of departments. Wood and iron. |
| Factory benches | Mostly shop-made wood benches with light plank tops. |
| Factory stools | All types to suit operations. |
| Drying kilns | Crawford sectional ovens and Gehnrich indirect ovens, gas fired for drying and crystallizing speaker horns. Many smaller drying ovens for enameling and heat treating. All gas fired. |
| Hot water heaters | Whitlock instantaneous type. |
| Wash bowls | Porcelain enameled iron in units 16 ft. long with 16 brass compression, stream-regulating, double, wash-sink cocks, 8 on each side. China index handles. |
| Closets | Vitreous china, extended lip type, with ebony Whalebone-ite open front seats without covers, low down tanks. |
| Urinals | Vitreous china. |
| Toilet partitions | Wood. |
| Drinking fountains | Manufacturing Equipment and Engineering Co. type. |
| Plant communication | Bell system extensions throughout. |
| Time system | Fifteen time clocks for in and out records. Arranged in batteries with pipe rail aisles. |
| First aid equipment | Complete emergency hospital facilities. |
| Rest rooms | Large room for women, well equipped. |
| Recreational facilities | Outside recreation field. |
| Cafeteria, etc | Concession to outside firm to serve lunches at two counters located in plant. |

# Hand Labor and Machinery as Producers

## Comparative Advantages and Formulas for Cost Calculations

By RHODES POLLEYS

EVERY executive, no matter what industry he may direct, is vitally interested in keeping production costs at the lowest possible figure. There are many important items of expense which he is called upon to keep at a minimum if a satisfactory statement is to be prepared for the stockholders at the end of the year. Perhaps the one item of most importance to the average manufacturer is his labor cost.

Many industries have expensive machinery for turning out their product while others are almost entirely dependent on the hand worker, due to lack of mechanical development in their particular fields. In this article both hand and machine labor will be considered from the standpoint of production and a method will also be shown by which a comparative analysis can be made as to their costs.

### Hand Labor Problems

The term hand labor is generally used to express the work turned out by the employee who performs his task without the aid of any mechanical devices except those of minor importance. Undoubtedly such a worker has distinct advantages as a producer. First of all, he is an artist and can give that final touch of individuality to his work which machinery can seldom duplicate.

In some lines of manufacture which cater to special trade, hand work is not only desirable but an absolute necessity if sales are to be made. This is particularly true of the jewelry and furniture industries.

Another point in favor of the hand worker is the ease with which he can be adapted to work in different departments of the factory. It is very convenient at times to have an extra man or two for speeding up production in the unit which is lagging in its schedule.

Perhaps his biggest asset is due to the fact that when his daily work is completed, there are no overhead costs on manufacturing tools to eat into the profits during nonproductive hours.

### Disadvantages of Hand Labor

Considering the disadvantages of hand labor, it is generally true that the product lacks uniformity and requires expensive supervision. This is very costly where products are made in large quantities, for it is necessary to have each minor part of the product alike in quality and dimensions so that it can be easily assembled. It is expensive business to make individual fits on each assembly of the article under manufacture.

Labor trouble might be included as a disadvantage of being dependent on hand labor, and it rightfully should be, provided the manufacturer is not required to employ large numbers to operate his mechanical equipment. If the latter is the case, labor trouble would, of course, be likely to occur with either method of production.

### Limits to Hand Worker's Production

First, last, and always, a hand worker's production is dependent on the human equation of Amount Produced = Skill + Will. It is very difficult to obtain uniform results when the last half of the equation must be drawn from a group of workers whose abilities and capacities are variable quantities.

Another serious disadvantage is the scarcity of trained hand workers. Business is seasonal in many industries and during their slack periods the employees are lost to various occupations. When the rush begins again, new workers must be found and trained at considerable expense for their places.

### Machine Labor Problems

Machine labor, which term we will use to express the work turned out by machinery although manually operated, has many advantages over the hand method of manufacturing. First of all, mechanical labor turns out a uniform product. This means that standardization is possible with all its advantages in quantity production work, as all duplicate parts of the final product can be made exactly alike.

Another advantage of machine labor is the fact that its output is generally much faster than the human machine. Also, new machine operators can be quickly taught owing to the work being more subdivided and concentration being necessary on only a few operations.

Not only is fatigue lessened by performing the hard parts of the work mechanically, but, in addition, machinery has a tendency to act as a pacemaker and spurs the operator on to increased output. Any one who has ever stood beside a machine worker who was operating under a piece-rate system of compensation, with perhaps a bonus for exceeding his quota, can appreciate what a stimulating effect machinery has on the worker. He becomes a part of the machine itself and learns unconsciously to cut every corner in

order that his mechanical pacemaker will not be delayed.

Machinery has its disadvantages. It is costly to install and must be carefully maintained in order to function at its best. Even when it is idle, machine expense goes on, as the fixed maintenance charges such as interest on the investment, depreciation, insurance, taxes, etc., must be set aside annually and deducted from the profits.

Unfortunately, also, it depreciates rapidly in financial value no matter how little use it may be getting. The second-hand machinery market governs its price and this, in turn, is largely controlled by the style or serial number of the mechanism rather than by its physical condition. This makes disposing of obsolete or excess equipment a costly transaction.

### Comparing Machine and Hand Labor

When an executive is considering the abandonment of hand labor in favor of machinery, he should proceed cautiously. There is something fascinating about mechanical devices and many times their production results are not comparable with those obtained from the hand workers. It is generally true, however, that machinery's advantages outweigh its disadvantages considerably.

Before installing such equipment, the executive must be certain that the volume of orders will allow him sufficient machine hours for the machine to pay for itself. This can best be determined by carefully analyzing the average yearly production of the operation in question and resolving it into machine hours. Knowing the cost per man hour it is an easy matter to make the desired comparison. If the saving is to be small, the chances are that the machine will never pay for itself, as replacement due to obsolescence or wearing out must be reckoned with.

In order to find out just where one stands from a cost standpoint when comparing the machine cost against the hand cost, the following formulas can be used:

Yearly Hand Labor Cost "A"

$$\frac{\text{Daily wage per man}}{\text{One man's daily production of machine)}} \times (\text{Daily production}) \; 270 = \text{Hand labor cost for production equal to proposed machine per year}$$

Yearly Machine Labor Cost "B"

$$\left\{\begin{array}{l}\text{Power}\\ \text{Interest on investment}^1\\ \text{Depreciation}^1\\ \text{Taxes and insurance}\\ \text{Repairs and maintenance}\end{array}\right\} + (\text{Total machine daily wage}) \; 270 = \text{Total yearly machine expense}$$

In explanation of the above formulas, the figure 270 is a constant which is taken as the average number of working days in the industrial year. This works out very conveniently, as the fixed charges can be estimated on machinery, yearly, with less effort and error than on an hourly or daily basis.

It will be noted that in formula "B" the first unit in the equation is made up of several items such as power, depreciation, etc. These items should be estimated yearly and their total cost makes up the fixed charges which must be included when figuring on the operation of any machine equipment.

### Machines Operated Under Royalties

Modern machinery is being used under various terms by the manufacturer and sometimes it is impossible to purchase equipment outright. There are many who, because of this fact, are dependent on special machinery which can be operated only under the terms of a royalty agreement. If such is the case, the above formula for machine labor costs "B" can be altered to take care of this condition. It will be necessary to substitute the total charges of the royalty or lease agreement, for a fixed production per day, in place of the first bracket. The formula might read as follows:

270 [(Royalty per production unit) (Daily machine production) + (Total machine daily wage)] = Total yearly machine expense

After the above formulas have been solved by using the figures of the particular problem, it is an easy matter to determine by comparison which method of production is the cheapest from a cost standpoint.

[1] Figured on "Original Cost + Installation Cost."

## General Electric Group Insurance

EIGHTY per cent, or 38,709 of the 48,435 eligible employees, have taken out additional life insurance under the group rate provided by the General Electric Company. The plan became effective November 16, 1925. The figures do not include employees of the incandescent lamp works, the Oakland, California, works, or the Pacific coast district, where separate campaigns are being conducted. This insurance is in addition to the free policies provided by the company.

The percentages of employees in the various works of the company taking the additional insurance are: West Philadelphia, 92; Erie, 91; New Kensington, 91; York, 89; Baltimore, 84; Philadelphia, 83; Fort Wayne, 81; Bloomfield, 80; River Works, Lynn, 79; Pittsfield, 79; Schenectady, 78; West Lynn, 77, and Bridgeport, 76.

In the general office, 76 per cent of the employees applied; and among the employees of the International General Electric Company in this country, 93 per cent applied. Eighty-five per cent of those in the merchandising division have applied. In the district organizations, the Rocky Mountain district led with 93 per cent, the Atlantic district was second with 90 per cent, and the Central district third with 88 per cent.

# How the Bakelite Corporation Effectively Manages Organized Research

## A Striking Example of the Modern Trend in Industry

By A. V. H. MORY and LEON V. QUIGLEY
*Associate Director of Research, Bakelite Corporation* — *Technical Editor, Bakelite Corporation*

RESEARCH is literally "a searching with care or diligence; a critical inquiry, or examination in seeking facts or principles; a diligent investigation in order to ascertain something."

A summary like the foregoing, though precise as a lexicographer might wish, would give us the idea that research was a drab business, conducted by devoted toilers who labored in a vineyard for medicine rather than spirit. Results there might be, and useful—but, never inspiring.

Instead, research is a living, active world of thought, unique. It is one of the most fascinating realms that human interest enters—its story, a great epic which has passed through generations. It has inspired men to unbounded triumphs and the happiness engendered by original progress. There is of course also the bitter with the sweet, and lost in the mazes of extended research, men have groped for a while, then lost their poise. The history of science occasionally records the tragic passing of those who have abandoned all when the investigations of a lifetime came to naught.

### No Royal Road to Success

There is no royal road to research success. Those whom it has baffled will agree to this, and none will give better evidence in proof than those whom we regard as eminently successful in its conduct. Research is a hard task-master. It is the profound guardian of Nature's secrets. Then should we not expect that those privileged to enter its inner court must be tried and found worthy of the trust?

The term research from its origin in the French word which means "to seek," and from its prefix, suggests especially the idea "to search again." Who in research has not tried, retried, and tried again to win a point? Research is desirably the province of men of painstaking, analytical, logical, pervading thought. Though they may aver that their confidence is intermittent, they are endowed with a stimulating hope and abiding faith.

Research may be applied to many fields of thought. Most especially we link it with the sciences, chemistry in particular. When years were read in smaller numbers, and costumes were quaintly picturesque, men researched in garrets and dungeons, and recorded their results in allegorical cipher. They were often secretive and thought little of making their toil of maximum service to a needy world.

That research was a thing desirable might be a premise granted by its practitioners, but many decades were to elapse before there was more general agreement as to its worth. It was when the group was served, rather than the individual, that the dawn of a broader appreciation was imminent. Research came to be looked to as the riddle-solver of industry, but many who needed it most, were no little skeptical, and even today, this condition in no small measure persists.

### Delving, and for What?

The scientist might delve for data and be content, but those in control of industry were often too busy to listen to his needs,—they were delving for dividends. When numerous actual demonstrations had proved that research in industry yielded dividends as well as data the world began to be more convinced. Research had come into its own, perhaps not as altruistically as could be wished, but very decidedly by a means which could best insure its expanding future for general welfare.

Since research has evolved from a private craft to a public enterprise, it has naturally assumed some complexity. It is now ordinarily conducted under some one of the following auspices: Individual; manufacturing concern; research company, consulting as specialists on varied problems; educational institution; and government bureau. No matter what the agency, the work is usually either on fundamental research, purely of scientific interest and having no immediate prospect of commercial use, or it is on a problem which is being solved especially for its industrial application.

### The Researcher and the Business Man

Formerly the researcher and the "business man" were different—so much so, that they did not cooperate well. The chief chemist spoke a different language, a language of symbols and technicalities which made non-researchers disinterested and bored. Recently there have appeared interpreters, who happened to be both chemists and "business men," and who by reason of a dual understanding, have been able

to do much in effecting co-operation. The influence of these "interpreters" is being reflected by the growth of large-scale research enterprises, which in the aggregate are backed by millions in dollars, conducted by thousands of workers, and directed by leaders pre-eminent in science.

### RESEARCH AND WHY?

A few years back, research was probably intensively entered by an industry only when its need became pressing. So much the pity. Had the development of investigation along fundamental lines been more progressive and provident, all science would have been materially advanced.

Nowadays, wise executives do not make research merely the headlight of their progress, but they try to light a safe highway of advancement, reasonably ahead of their train of immediate thought.

There are a number of institutions in the United States which spend great sums on vast departments of organized research. In proportion to its size, the corporation which engages in the manufacture of the chemical products sold under the trade mark Bakelite, invests a relatively large per cent of its earnings in research. Bakelite owes its birth to research, and quite naturally looks to its parent for the best precepts of healthy growth.

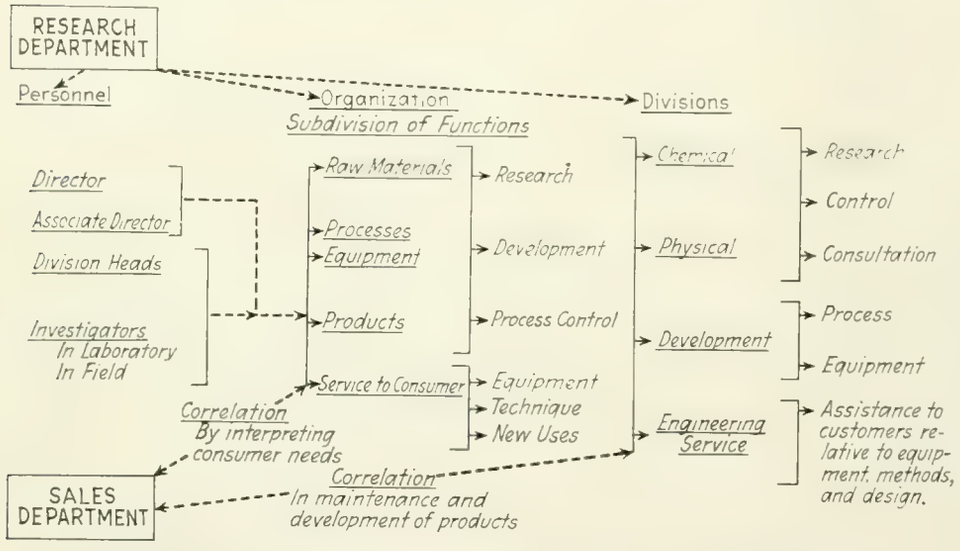



FIG. 1 CHART SHOWING HOW THE BAKELITE RESEARCH DEPARTMENT FUNCTIONS

### RESEARCH IDEA INHERENT IN BAKELITE CORPORATION

Bakelite is the product of the brilliant and intensive research of Dr. L. H. Baekeland, American chemist, who announced his results in 1909. Under Baekeland's leadership, the Corporation is imbued with the spirit of research and is uniformly convinced of its manifold and far-reaching value. Under the immediate direction of L. V. Redman, also an early worker in phenol resins, research and development is being conducted along many lines, all in the direction of improved product and broader industrial application.

While a description of the laboratories and their equipment might be of some interest, we shall confine our attention to the subject of management. The chart presented in Fig. 1 is a delineation of how the unit functions, and is included because it may help the eye to visualize what the mind is gathering from the print.

While those experienced in research have frequently affirmed that over-organization is detrimental to initiative and efficiency, it must also be apparent that a department may have so many specialized problems that a quite definite system of distribution must be adopted to facilitate their successful handling. The Bakelite Corporation research personnel consists of director, associate director, and investigators, these latter being variously classed as division heads, researchers, and assistants. The lines and titles on the chart give a general concept of how the department is organized and how it operates.

Grouped under organization have been listed the principal classifications of the work in which the research department engages. These headings may be in turn quite complexly subdivided. Raw materials are fundamentally important. Whether produced or purchased they must conform to rigorous specifications and their progress in reaction is subject to vigilant control. Investigation tending to improve their methods of production and standards of quality is also conducted. The furtherance of these aims involves both pure research and development work.

The development of processes, and the provision of special equipment, as well as the standardization of both, is work which very naturally comes under the surveillance of a separate division. Products and processes which, after exhaustive preliminary research, show special promise of industrial importance, become the subjects of development on semi-works scale as the first conservative step toward full-scale manufacture. "Make your mistakes on a small scale and your profits on a large scale" was the motto of Dr. Baekeland in his early work and is the fixed policy of the Corporation today, as indeed it is of all wise and conservative manufacture.

The ability of the Research Department to serve the consumer's needs is a point which the Bakelite Corporation emphasizes. It offers continually to co-operate with customers and prospective users in the solving of their problems. This provision of extensive specialized facilities, and a quite copious industrial experience, is frequently a great boon to manufacturers whose equipment and experience are more limited. The Research Department has very often been able to co-operate with the consumer by aiding him

in effecting practical design in product, suggesting proper equipment, and guiding him to technique calculated to produce best results.

Satisfactory handling of the many problems is made possible by the fact that there are a number of divisions which function co-operatively, though individualized in the details of their work.

The Chemical and Physical Divisions, while pri-

FIG. 2 LABORATORY UNIT

With such equipment research in materials and processes [illegible]

marily engaged in research, serve Development and Engineering Service in a consulting capacity.

The function of the branch entitled engineering service must already be evident. Generally speaking, this service involves either the correcting of manufacturing difficulties encountered by present users, the introduction of Bakelite products to prospective users, or the guidance of customers—both new and old—in new applications of these products. The engineers in this division often devote considerable time to study and experiment in helping a prospective user so to develop his equipment that full advantage of the special characteristics of the Bakelite materials may be secured.

### WIDESPREAD APPLICATION OF BAKELITE

To appreciate the function of research in a business, certainly some picture of what the business is, must be requisite. So prevalent has the use of Bakelite become, since its invention, that hardly a person on the civilized portion of the earth has failed to see it or enjoy its use. To know the myriad ramifications of its application is to be thoroughly convinced that such a statement is indeed true.

Perhaps some of you who are reading this article have forgotten what Bakelite is. You're sure you've seen the stuff but can't remember whether it's a trick metal, or an improvement on amber. Maybe you would swear it was a wood, like teak?

The clear, amber-hued Bakelite is made by allowing phenol (carbolic acid) and formaldehyde solution to react under heat and pressure. These two foul-odored liquids react to yield a clear solid which is both chemically and physically without the slightest resemblance to its constituents. Such is the power of chemistry, wonder science of the ages!

Of course this is by no means the whole story. Further heat with pressure makes the molecules cavort more merrily and join in groups. An odorless, transparent, highly refractive, dense, hard, strong, infusible, insoluble substance is the result.

### INCORPORATION OF OTHER MATERIALS

To go back to the fundamental resin resulting from the phenol-formaldehyde reaction,—it can be finely ground, and incorporated with materials like wood flour, asbestos, or graphite, to form molding materials suitable to the needs of strength, heat resistance or self-lubrication. Or, instead of this, the resin may be dissolved in solvents to give enamels, varnishes, or lacquers. Moreover, the varnish may provide a dipping bath for sheets of canvas, linen, or paper, which, when freed of solvent and subjected to heat and pressure, are transformed to tough, rigid plates from which articles as contrasting as silent gears and radio panels are successfully cut out.

The transparent variety has been your cigar holder, shift lever ball, or fountain pen, perchance, and you

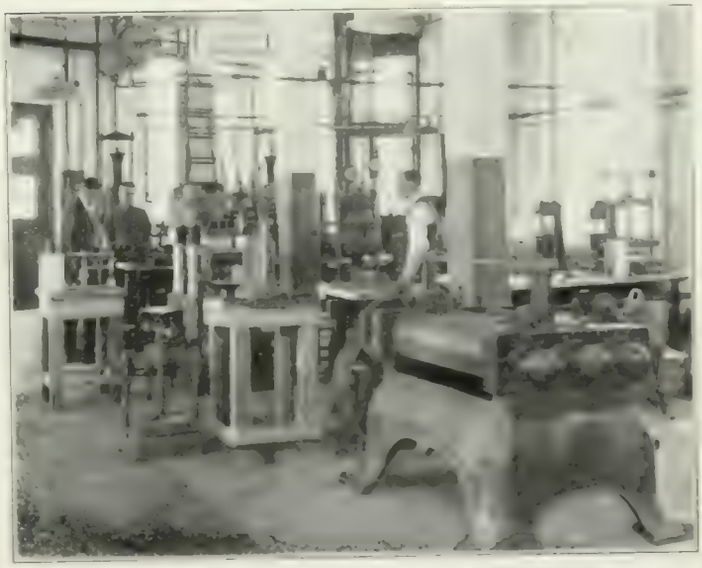


FIG. 3 EXPERIMENTAL MOLDING EQUIPMENT

Here conditions for thermosetting molding materials [illegible] speed testing.

have seen it in jewelry of great beauty. Your automobile has a distributor head of Bakelite molded, and the wattmeter case at the power house is molded of the same. We have not space to tell what interesting stories surround the application of Bakelite on every American automobile and truck, on nearly all the radio sets, on railroads under and over the ground, and on the leviathans of air and sea. What we have indicated

however, is convincing proof that such a business is justified in making research a major part of its program.

The large investment in research, by the Bakelite Corporation, and by other concerns for that matter, is only justified from an economic standpoint by improvement in quality, by extension of product application, and by augmented sales.

### Research and Sales

As indicated in the chart, there is reciprocal effort between research and sales, in the interest of product maintenance and improvement, and in consumer service.

In addition to the engineering service rendered by the Research Department is that afforded by the Department of Sales. The latter department might be considered as consisting of two main divisions, namely, the central organization, interpreting consumer needs, analyzing markets, and handling distribution generally, and the outside organization consisting of sales engineers. These latter are all technically trained men, and are by no means mere order-taking salesmen. They are specialists who can aid customers and prospective users of Bakelite in solving many problems connected with its application. When they have demonstrated the effectiveness of Bakelite for a particular service, orders are a natural consequence.

In the research laboratories, on the other hand, is a trained staff of competent advisers whose data the field engineers apply in their problems. It must be readily appreciated that since the men in the field know the problems confronting their products, and are in touch with consumer needs—and since the men in the laboratory are skilled in adjusting materials or conditions to manufacturing requirements—two such groups can work wonders when they come to a meeting of the minds. This really must strike one as a research consideration of paramount importance, yet it is undoubtedly a feature which some organizations have neglected to encourage.

### Two Heads Better Than One

Whenever a manufacturer and Bakelite research engineer get together, ideas are generated. No doubt most executives and engineers, when convinced of a material's special suitability to their needs, will adopt it forthwith. Often the peculiarity of the problem makes its solution come necessarily within the province of a research division. Perhaps some experimental work must be done which is beyond the ability or equipment facilities of the manufacturer. The Bakelite laboratories may already be equipped to conduct such an investigation and with good effect. The sales engineer can well arrange the details.

It need hardly be stated that this service to consumers is conducted in an ethical manner. There is no obligation incurred by requesting the call of a Bakelite engineer, and he is always a respecter of confidences with regard to product, plant, or whatever entrusted to him.

But let us cite a few of the applications of research to plant problems; their variety is great, as would be expected since they pertain to *The Material of a Thousand Uses*. The first problem one week may be on the design of a bushing for high speed bobbin spindles, and the next be about the possibility of molding banjo frames from Bakelite. Perhaps insulated parts on a hair-waving machine may next furnish a problem, and be followed by the question of coil impregnation in generators and motors. The question of putting Bakelite beaded designs on cloth, and the advisability of using Bakelite laminated vanes for high speed rotary pumps will each be referred to the proper specialists. The matter of subway insulation, or electric burglar alarm parts will get careful attention, and so will the design of radio condenser end strips.

Much interesting research and development work often precedes the introduction of Bakelite to replace other materials of construction. Perhaps it will pertain to the use of Bakelite for buttons, and will be prompted by the difficulty experienced by the manufacturer in obtaining large size ivory nuts when the market has been bought up by foreign interests. Or perhaps tool handles which were formerly made of apple wood can be molded of Bakelite with a result of finer finish, better grip in the hand, perfect uniformity, and lower cost.

### Chance of Effecting Economy

Before Bakelite replaces some other insulating material for a switch part, there may have to be a careful study of design, and a rather complete analysis of manufacturing cost. Ordinarily the cost of material may be greater when Bakelite is used. Rather is the chance of effecting economy likely to arise from the elimination of hand labor in assembling metal parts and in finishing, in addition to which greater accuracy in dimension is likely to be insured.

Moreover, the opportunity of rendering valuable service may arise in connection with the installation of molding equipment of demonstrated economy and effectiveness. Counsel in this matter may save the new user of Bakelite costly blunders and annoying delays.

One might go on ad infinitum to tell of the Research Department, its functions, and demonstrated results. Sufficient has been said to make the picture fairly clear. It is also hoped that another chapter has been added to the gospel of research in industry.

Research is the province wherein the profoundest minds may never tire of seeking and re-seeking. It is a difficult school but its rewards are commensurate with its rigors. Linked with industry it enjoys its broadest service for human betterment. Thinking men must indeed be gratified in knowing that the industrial organizations whose prominence is outstanding are making research a large item in their annual budget.

# Scope of Financial and Industrial Investigations

## Conditions and Sources of Data

BY ARTHUR ANDERSEN

*Arthur Andersen & Co.*

IN the past few decades the conditions of industry have been greatly changed, principally through the perfection of labor-saving machinery which often can produce more units of a certain product in an hour than could formerly be produced in a week. This tremendous mechanical change has given rise to various industrial and economic changes. In the first place it has tended to decrease the number of men required by industry, and so has led to the development of new products, new industries and new uses for existent products. In the second place it has demanded a far wider distribution of all products, an increased market.

Fortunately mechanical advancement itself provided the means for greater distribution, giving improved instruments of transportation and communication. The steam and electric railroad, steam boat, automobile, truck, airplane, telephone, telegraph, radio, printing press, all have been developed or improved to aid in the nationalization and internationalization of industry. But as markets have broadened and as all mechanical devices have been continually bettered, these very factors have, in turn, placed a new pressure on industry, demanding greater and greater production facilities and larger and larger industrial units, thus creating a regenerative cycle of growth.

Larger industrial units have led to a multiplication and magnification of all of the problems of financing, purchasing, manufacturing and merchandising. Mass production is possible only if there is an assured and steady supply of raw material; it is possible only when all manufacturing departments work to controlled standards and in a co-ordination of time and quantity; it demands a balanced relationship between sales demand and production schedules; and it requires the closest attention to finance as related to the producing and selling programs.

### Change in Ownership

In the matters of finance, industry is changing from sole proprietorships and partnerships to corporations and these corporations are continually demanding a more widely contributed capital. The increased capital requirements have led to more public financing, greater bank loans and continuous refinancing. This process leads in turn to the relationship of management with bankers, lawyers, appraisers, accountants engineers, stock and bond brokers. It necessitates audits, statements, improved accounting, budgets, perpetual inventories. In the matters of sales and distribution the large industrial unit is involved in problems of freight rates, ocean freights, international exchange, international credit, foreign agencies, branch house control, sales budgets, national advertising, tariffs. On the production side there are problems of engineering research, design and development, patents, processes, materials, sources of supply and mechanical improvements.

All of this merely presents a picture of things as they are and gives some idea of the modern trend toward greater size and complexity of the industrial unit. Recently there have been some striking examples of the growth of particular businesses. This growth may be by reason of expansion from within—as was at first the case with the Ford Motor Company—or by the acquisition of supplemental businesses and industries to form one "vertically integrated" structure—as is the present policy of the Ford business. Or it may result from the combination of similar industries to form a "horizontal integration," as was the case with General Motors, International Harvester Company and the Standard Oil Company. In any event the tendency is more and more to combinations and mergers and it is useless to attempt a forecast of what may eventually come about in the way of huge business structures. An ultra-modern effect is seen in the recent efforts of the Stinnes interests, which became international in their program of combination and acquirement.

This means that the problems of business also will increase and will attain a complexity and variety even greater than they have at present. It is possible to see that the purchasing functions of a great business may become those of divisional co-ordination rather than of merchandising. That is, one industrial structure may own and operate its coal and iron mines, its palm, cotton or olive plantations, its timber tracts and sawmills. It may carry the raw materials so produced on its own railroads and vessels to the points of fabrication or distribution. It may operate intermediate processing plants such as refineries, blast furnaces, rolling mills, planing mills and spinning mills. Its warehousing facilities may be tremendous. The final manufacturing units may draw on all of these pre-

liminary processing elements and may feed a multitude of sales products to an international merchandising organization. It may operate banks and insurance companies, newspapers and printing plants, may administer communities of employees with the infinite details necessary to everyday life. Many of these elements already exist to a greater or less degree, marking the first steps toward a true industrial socialism.

### Place of the Financial Investigation

With the expansion of industrial units the matter of outside financing has assumed a continually greater importance in the affairs of modern business. The past ten years have witnessed also an increasing degree of responsibility upon the part of investment bankers with respect to securities which they place before the public. This responsibility not only concerns itself with the immediate history of the issue, but also with its probable future in terms of interest and principal obligations. At the same time there has been a decided tendency throughout the United States toward financing businesses on a long term basis. The natural consequence of these trends has been to develop such methods of analysis as may, to some extent, be used in forecasting the future of a security issue, and also, to some extent, in suggesting safeguards which may preserve its soundness.

These methods of analysis have in a way been forced upon management. It is to be expected that management will be an unintentionally *biased* party and will be itself convinced of the necessity for a security issue; will believe that the proceeds of the financing are to be correctly applied; and will see no real need for any extensive analysis of conditions. On the other hand the investment banker has seen too many instances of business failure to accept at face value the opinions of the management, even while retaining also a certain *bias* in favor of the issue. Therefore, the day is practically past when the company's statement "per books" is accepted as a basis for long term loans. The audited statement is both the bankers' protection and the managements' own instrument for internal control. Its position is so well defined and its use so customary that the yearly audit or the audit preliminary to refinancing attract no more than passing attention.

### Place of the Appraisal

Still other forms of analysis are, however, neither so well established nor so well understood. Recently because of the wide fluctuation in fixed values and because of past lax handling of plant accounts, the appraisal has begun to attain a standardized place in business analysis. The financial and industrial investigation is still somewhat immature in development and uncertain in its use and status, yet promises to be one of the most effective methods of analysis in the event of refinancing, especially where there is to be a public offering of securities.

Anyone who has made a study of business realizes that the true security behind any issue of securities is not the cash in bank, not the accounts receivable, not the inventories, not the plant, nor any of these tangible assets. But the real security behind any issue is the more intangible factor of management which is the cause of the flow of earnings from the use of assets.

While management is always the most vital single element in business, it assumes a broader importance when refinancing is contemplated, because upon this factor rest the expectations of bankers and security holders. Within the loan period of 10, 15 or 20 years the conditions of any given business may change greatly. Patents and copyrights may expire; public favor may change; new inventions in that or in other lines may influence many external conditions; local labor, transportation and sources of material supply may be subject to wide variations. If management does not compensate for these changing conditions by changing the equipment or policies of the business, profits may disappear. Yet even though management is the principal point to be studied, the analysis will be incomplete unless all of the facts of equipment and conditions are also known, since these facts set up the standards for judging the effectiveness and the requirements of management.

The effectiveness of management in the past may be partially gaged from the results shown by correctly audited statements and statistics, but even here the conditions must be shown, since profits sometimes flow from patent monopolies, distribution monopolies, or favorable labor or material markets, in spite of laxness in management.

Present conditions and the trends of conditions may be infinitely more important than the balance sheet and the profit and loss account. Unfortunately, these more vital points are the more intangible points. Experience, knowledge and practiced analysis are required to draw conclusions as to the trend of public favor, trends of the industry as a whole, trend of the economic cycle, the status of the company in the industry, arrangement of organization, personnel, etc.

### Differences Between External and Internal Investigations

The external investigation is always largely concerned with past operations as a basis for judging the future, but the internal investigation, on the other hand, is usually concerned with some defect in present operations or present methods. The external proposes to indicate the future course of the business in a broad way, but the internal proposes detailed corrections in order to give generally better future records and operations. The external is broad in scope and most of these investigations cover the same general outline of points, but the internal is usually more detailed, confined to a relatively few points of procedure, with each such investigation very distinct in itself and different from all others. Even if the internal investigation covers a fairly broad field it will do so in the form of

a general preliminary survey, to be later supplemented by individual investigations of each important section, which are often intermingled with considerable "installation work."

Thus the scope of an internal investigation may extend from a broad survey of the business as a whole, to determine the causes of existing weaknesses, to a study of some very minor point, such as the best method of setting up a certain card index, or the proper form of inventory record in a small warehouse.

Fundamentally, the difference between the two forms of Investigation is that the external discusses conditions with a third party for *protective* purposes, while the internal discusses conditions with the management for *corrective* purposes.

### Points for Internal Investigation

Since the internal investigation covers usually the present operating conditions it will only rarely touch such points as markets, condition of the industry, position in the industry, financial policies, etc., which so often are vital and significant points in the external survey. If it does touch these points it will usually be as a part of the problem of investigating budget possibilities, or of developing a new sales product, or correlating sales with production. These, however, are the more unusual subjects for analysis.

The more usual points are those in connection with

1. Organization
2. Materials control
3. Labor control
4. Production control
5. Cost control
6. Accounting records
7. Sales records
8. Miscellaneous records

Of all of these, probably, costs call for more investigation and installation than any other one problem. This is because cost of sales which, next to sales, is the largest and most important item in the operating statement is, at the same time, the most complex; yet the cost department is of necessity a hybrid, tied on one side to the shop operations and on the other to the books of account. Not infrequently there is no definite supervisory responsibility over the cost work, which may or may not be tied into the books.

Moreover, any investigation of costs must include an investigation of labor, material, production and burden controls, as well as some study of the accounting systems and records, which makes a cost investigation just about as broad a field as one could wish to cover in complete detail.

The internal investigation is so special and so detailed in most cases that very little standardization of data and methods is possible. The external investigations usually follow basically similar lines, and certain sources of data must always be taken into consideration. The following sections therefore apply particularly to investigations made for purposes of financing, although many of the same points may arise in the course of internal analysis.

### Data Used in Investigations

The data gathered in the process of making an investigation varies and has varying importance according to the particular situation. It varies not only by reason of the internal condition of the business but also by reason of the type of security issue which is proposed.

Thus in an issue of bonds one of the first factors to be considered, though this does not mean the most important factor, is that of property values. Here it is probable that considerable dependence must be placed upon an appraisal. Because of the difference in property values from a "going business" viewpoint and a "liquidation" viewpoint the banker is used to setting up a certain margin or factor of safety between the amount of the bond issue and the apparent value of the property.

### Data from Appraisal

The facts brought out by the appraisal, however, cannot be accepted blindly by the investigator who must first study and weigh the appraisal in order to grasp its true significance. The appraisal, for instance, may have been made at a time of low dollar values, such as we have at the present time and had to a greater extent in 1919 and 1920. This may mean that a property which cost new $1,000,000 will be appraised at $2,000,000. This in effect represents the market value of the property. But it is only the market value in case you have a willing or eager buyer. Also, it is a present market value, and if the value of the dollar should change as it does almost continuously this value will change. Thus the commodity index by Babson was as high as 297 in the year 1920, whereas now it is close to 170. This means that the average something which had a market value of about $3,000,000 in 1920 now has a value of about $1,700,000. The consequence is that plant values as set by appraisal in 1920 have already suffered a great value deflation which has similarly reduced the safety factor of any bond financing predicted on these appraised values.

On the other hand, it cannot be assumed that book values, or cost, are always a safer basis for determining plant values, since it may well be the case that construction was carried on during a period of inflated values and that a subsequent deflation has left an unreal book figure.

It would appear then that almost any data used by the investigator is open to question and analysis, and this is really the true answer, for no data can be accepted for the purpose of the investigation at its face value, no responsibility for actual facts can be shifted on to some other person or some other firm. So in the case of appraisal data the investigator checks it from several different viewpoints, regardless of whether or not it is used in the balance sheet.

It is checked first as to date which in turn correlates with economic cycles to indicate a period of abnormal, normal or subnormal dollar value. Then it is checked by comparison with the book figures, determining the years of principal construction and fitting them also into the economic cycle. If the case appears important it may be advisable to go back over a period of years to apply an adjusted basis of depreciation or to inspect in some detail the property accounts for wrongly capitalized expenditures, or the maintenance and repair accounts for charges which should have been capitalized.

There are, moreover, other important items, especially as applied to the equipment account. The appraisal may set a high value on jigs, patterns or dies which are special to certain orders, which have no value unless there are continuous repeat orders, and which may actually have been charged into the cost of the original job. These values do not support a bond issue and must be separated out in any comment on plant and equipment assets.

Similarly much of the equipment may be in the form of special machines which show a high appraisal value, but which may have no sale value except as junk. They also do not support the issue even though they properly have a place in the accounts and in the appraisal as a value to the going business.

Even the buildings may not have a real liquidation value in the amount indicated by the appraisal or depreciated cost figures, by reason of a number of conditions. They may be of unnecessarily expensive construction, or they may be of a type difficult to adapt to any other line of business, or they may be located in some place remote from other manufacturing businesses—just some local industry which has grown up far from any industrial center and dependent upon local labor and local goodwill. Any of these conditions would act adversely when it came to selling the buildings.

From these facts it is easy to see why the bankers like to have at least a two-to-one ratio between fixed assets and the size of the issue. It is also easy to see why the investigator cannot merely *accept* the data which comes from other sources. It is not sufficient to secure the truth, the whole truth must be known.

## LEGAL DATA

Just as appraisal data are essential, yet must be tempered with information from other sources, so certain legal data are necessary yet must be used in a practical sense.

Situations of this nature arise in connection with the determination of whether a company has a direct or contingent liability for Federal or State income taxes. Even where the audit has been made by other accountants, and where legal advice has been taken in the matter there still remains a responsibility on the part of the investigator to determine whether the tax situation has been correctly handled.

It may happen that there exists an unstated liability great enough seriously to upset the profit figures for past years and to cause a weaker financial position than that stated. On the other hand there may be a possibility of reducing the stated liability or of securing a refund. It may also be that the assessment has been made and that the financing must be arranged to take care of fairly immediate cash payments.

At still another important point legal data enter into the investigation, this time in connection with the present situation. It may be that the company is suing or being sued, and the status of this litigation will have a bearing on contingent liabilities and possibly on the whole future of the business. Thus there was litigation on the basic Bell telephone patents during their entire life and an adverse decision as to their validity would have changed the entire history of a number of companies. Not only would it have affected the Bell company but it would have changed the course of the entire industry. A somewhat similar situation exists today in the radio industry, though probably in a more complex form, for not only are basic patents involved, but also a multitude of manufacturing and design patents. Various companies admittedly copy the product of others, and not merely on a "bootlegging" basis. Another striking example of an involved and serious patent situation is to be found in the patent history of the automobile industry, in which the Selden patent was declared invalid by the Supreme Court only after millions of dollars in royalties had been paid.

This legal patent factor comes up in many investigations. It has an effect in determining income, liabilities, future prospects and present policies. Thus some companies under strong patent protection lease their machines instead of selling them, getting a large rental income which will probably cease or be materially reduced after the expiration of the patents. Policies must be so shaped that the transition from a protected situation to a competitive situation may be made without undue loss of income.

There is another angle to this problem, in that patents may carry a large balance sheet value, which may or may not have been depreciated. If the value has been set up in an unreal fashion, through appraisal or excessive assignment of stock, and if adequate depreciation has been provided on the patents on the basis of their book values there may result an element of concealed earnings; or if the patents have not been depreciated, earnings may have been overstated and a write-off of the patent values against surplus may be required on their expiration. Or it may be that depreciation has not been taken in the past, but may be permissible, and may result in a reduction or refund in the prior years' income taxes. The whole question of patent depreciation and the possibility that expenditures for patents may eventually, with propriety, be merged *in toto* with goodwill is, of course, a question to be considered in each individual case. The answer depends largely upon the success of the company in building up goodwill during the protected

period. In any event, the investigator must secure all possible legal and practical data regarding the patent situation and must digest and analyze it for its effect on the various phases of the business.

### Research Data

Still another class of data which must be gathered and used during the investigation may be called research data. This is of various sorts. Very often, as a preliminary, a study is made of all of the published financial data on the company, for which Poor's and Moody's Manual is the chief source. It may be necessary to go back in these volumes for 10 or 15 years, picking out essential data and having it transcribed for the working papers. Often it is surprising to find how much data may be so gathered on sales, on profits, on balance sheets, on history and financial reorganization and on personnel, much of which is useful in establishing a background for a true understanding of present conditions.

Unfortunately, also, it depreciates rapidly in financial value.

Sometimes this same source permits of gathering data on the company's principal competitors and gives a gage for judging whether this particular business is maintaining proper profit and expense ratios. Such data are of course incomplete, uncertain as to composition, and must be used with caution.

Again, there are industries and businesses in which tariffs are a vital factor and in such cases it is necessary to get not only the existing rulings but also some knowledge of contemplated legislation. For this class of research data one is led to government bureaus and trade associations. Just to illustrate the situation consider the cutlery industry. Here the American manufacturers are in direct competition with Germany. The war has not changed this condition appreciably. Germany excels in its tool steels and pays a price for labor so astoundingly low that often its products can be given a retail price in this country which is lower than the cost of production for American manufacturers. Tariff is at present the only prop which can possibly uphold this industry. Much the some thing has been true in the past in the dye and chemical industries, and is still truer than is comfortable to contemplate.

Data of this sort are vital, but often other data on the industry are essential even though not quite so important as the tariff condition just noted. For example, the growth of the industry, its total size (expressed in sales, investment, etc.) and its general history should be known if the particular business is to be assigned its place in the industry and if its problems are to be fully understood. For such information one goes first of all to the files of government publications. Usually such data are dependable, but very often are incomplete and care must be taken to sift out what is authentic from what is statistical. Thus the "Census of Manufacturers" now published each five years is probably as accurate as such information can hope to be, but the interim data by years probably will be based on partial or incomplete returns and figures.

One of the surprising things about such research is the great mass of often very detailed data which has been compiled by the U. S. Government on the major industries. On agriculture the information is not only complete and detailed but also very closely up to date. The same thing is true to a lesser extent of the iron and steel industries.

In many of the industries there are trade associations which have unusually complete information on file. The Rubber Association of America is typical.

The search for data is almost a profession in itself and there are firms which specialize in this type of service. A similar, yet basically different, source of information is that of the business forecast services, which deal with business as a whole, with certain specific industries in detail, with certain phases of industry (such as the labor question), and with general data on a number of industries. Primarily they supply data on the current situation or else attempt to forecast the trend for a year or more in advance. They have great value, for this purpose, but must be used with discretion since facts must be differentiated from opinions and opinions may be based on incomplete facts.

The investigator must know how to make the best use of all such sources. Often data must be secured from all sources and then correlated, sifted and judged, to arrive at the true picture. Seldom can research data be accepted at face value and often great masses of non-essential data must be gone through in arriving at the significant facts.

### Accounting Data

Naturally a great deal of information must be drawn from the company's own records and it is often a question of what to get, how much to get, how much to omit and how to set up these data in the most forceful form. At first glance, it would appear that there is little sequence, logic or connection to the figures which can be secured.

However, the bulk of the essential and useful material is contained in a connected logical form, the profit and loss statement. By this is not meant merely the usual profit and loss statement, but one which covers a fair period, usually five, but sometimes as much as ten years.

This statement can first be set up in a very condensed manner, having the principal items of net sales, cost of sales, gross profit, other income or deductions, selling expense, general expense, special expenditures (such as Federal Taxes) and finally surplus net profit. In this form it usually appears as the principal profit and loss exhibit in the report. Supporting this summary statement detailed tabulations will be prepared analyzing the various sections. Probably sales will be shown by the more important classifications of goods sold and, if possible, cost of sales and gross profit. Then cost of sales may be analyzed as a whole in considerable detail, with particular reference to the items

composing manufacturing burden. Another schedule will analyze in detail the items of selling expense while others will similarly analyze general and administrative expense.

Thus there is prepared a complete tie-up analysis of profit and loss over a period of years. In preparing is there is needed a large element of judgment in deciding just how much detail will be shown. Carried out to the extreme of original entries would of course result in the detailing of every transaction taking place in the business, which would then be useless. In other words, the purposes of these statements are summarization and analysis, which in a way are opposite qualities, so the final result is a balance between detail and final figures.

From these analyses one may determine the trend of sales as a whole and by products, gross profits by lines, trends of principal expense items, ratios of various expenditures to sales, trends of net profits, as well as make a multitude of other facts which will have a distinct bearing on company operations and the qualities of management.

### USE OF BALANCE SHEETS

In addition to this accounting data, setting forth the results from operations by years, there will also be required balance sheets, as at the end of the period, the beginning of the period and preferably at the end of each year in the period under investigation. These will permit stating the trends of inventories, of current assets and liabilities, of fixed assets, of cash, and of receivables, loans and payables. Such analyses are usually best expressed as ratios, usually the ratio to net sales or net profits, but often to each other. The full discussion of the more significant ratios is reserved for later consideration.

From the above data also will be drawn off an application of funds statement which is often one of the most significant single items in an investigation, showing as it does the use management has made of the funds provided.

In some cases the accounting data may be carried a step further. All of the above compilations deal with past records, but it is possible to assume an expected sales volume and then, using the financial relations developed from past experience, to set up a forecast for the coming year. Usually this will be done where the cash position is a vital factor in order to show the bank loan or other credit requirements. Thus there might be developed what is practically a budget for the coming year, and evidenced in monthly balance sheets and profit and loss statements. As has been stated, this is an unusual procedure, but very illuminating if the company appears to be in a dangerous financial position. It is more likely to be done where an issue has "gone bad" than where a security issue is contemplated.

All of this is what may be called routine accounting data. Undoubtedly, in most investigations, there will be a need of special accounting information and analyses incident to the compilation and verification of the results contained in the exhibits. These data take the form of comments on the handling of the accounts, with special reference to the deficiencies in procedure disclosed by the examination, classifications of receivables according to age and collectibility, studies of the company's depreciation policies, surplus reconciliations, etc, etc.

### RELATIVE IMPORTANCE OF DATA

While a complete and detailed analysis of a given situation would result in a great mass of information, not all of this material would be pertinent or necessary for the purpose of investigation. A sense of discrimination and relative values must regulate the manner in which the analysis is made. Thus a hasty survey may indicate beyond a doubt the stability of the industry, generally sound policies of merchandising and manufacturing, satisfactory qualities of management. This throws greater importance upon the audit and financial findings, which may then compose more than three-fourths of the entire report, concerned primarily with the average earnings, the various values of assets back of the issue, the position after financing, etc. In short, the report may be concerned primarily with the analysis and interpretation of the facts disclosed by the audit.

On the other hand, the audit and financial data may be unusually complete and satisfactory, the vital questions being those of the industrial future of the business. An example of this latter type might well be found in connection with the financing of a brewery business in 1920 or 1921, when the effects of prohibition were problematical, when the future success of the business might be dependent upon the qualities and marketability of entirely new products, when an entirely new distribution system was being inaugurated, when even new operating processes and personnel were being developed. Here the report could briefly deal with the financial aspects of past performance and present position, but would be forced to give a lengthy and detailed analysis of the industrial problems of the present and future.

A somewhat similar type of report would be required preliminary to the financing of a rubber company in 1921 or 1922, when a tremendous overexpansion of the entire industry had vitally changed the prior industrial status, and when the rate of growth of the automobile industry became a dominant factor in determining when conditions might again approximate a pre-1920 normal.

Factors, such as those just outlined, might cause two reports to take entirely different forms, even though the broad scope of the two investigations was fundamentally the same. In this, the experience and judgment of the investigator come into full play, not only in setting the proper emphasis, but in so shaping the report that the necessity for this emphasis and the importance of certain conclusions is clearly conveyed to the bankers and the management.

# Coal Handling and Boiler Operation at Northern Paper Mills

By H. W. GOCHNAUER

[illegible]

IT has been said that there are three principal prerequisites in the manufacture of paper—wood, coal and water. Wood is the principal ingredient, coal is needed for process work, and water as a conveyor.

The Northern Paper Mills, home of "Northern Tissue," is located at the mouth of the Fox River, in the city of Green Bay, Wisconsin, and thus is near the timber lands. Another distinct advantage in the location lies in the fact that although geographically the Northern is far removed from the coal mines, it is, at the same time, relatively close to the coal supply, as excellent dock facilities are available at the site.

### Handling Coal

Coal is brought from the eastern mines through the Great Lakes by boat and placed by these self-unloading steamships on our dock, immediately adjacent to the boiler plant. See Fig. 1. The self-unloading ships have a capacity of from 4,000 to 6,000 tons and through their use, the investment of expensive unloading equipment is avoided. About 32,000 tons of the 40,000 annual requirement have been obtained and delivered in this manner. The remainder is switched by car from the local coal docks. The result is a fair stock of high test eastern nut and slack coal delivered near our boiler plant, with no expenditures for unloading equipment and at a price under $4 a ton.

The Northern Paper Mills boiler plant is equipped with three 400 H. P. and four 300 H. P. Stirling boilers, equipped with Type E Combustion Engineering Company stokers. See Fig. 2. Coal for the stokers is furnished by a traveling electric weigh larry of 1000 pounds capacity, supplied from a 100-ton over-head steel coal bunker. Coal is conveyed by means of an elevator bucket conveyor from a track hopper beneath a switch track near the boiler plant. The coal from the stock piles on the dock is moved by scraper chain conveyors, which are located under the coal pile and lead to the track hopper.

The records of the coal received and consumed are of perhaps more importance than the physical manner in which it is handled. Vast sums can be lost by negligent supervision. The weigh larry permits of the weighing of the coal consumed in each individual boiler. A box with separate compartments and slots is provided. Coal is weighed into a stoker and the weigh ticket is punched and dropped into the slot representing that particular boiler. In this manner, it is possible to obtain the summation of the coal supplied to each boiler over any period of time by collecting and totaling the weigh tickets. A specimen report is shown in Fig. 3.

Republic flow meters are installed on all of the

Fig. 1. Self-Unloading Coal Boat at Dock of Northern Paper Mills

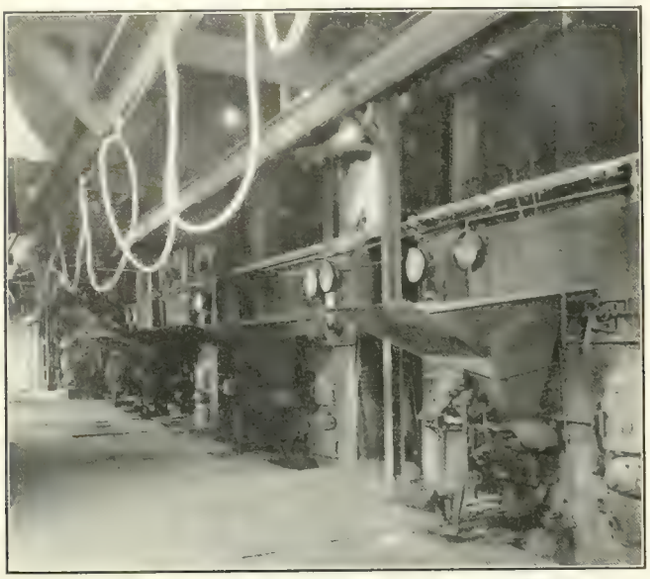


FIG. 2 BOILER ROOM, NORTHERN PAPER MILLS

boilers, and also on the main headers to the several mills. Thus it is possible to obtain a record of the steam produced by each boiler by the entire battery

**NORTHERN PAPER MILLS**
ENGINEERING DEPARTMENT
Steam Records

DATE, Dec. 2, 1925

| PRODUCTION | COAL CONSUMED POUNDS | STEAM GENERATED POUNDS | HOURS OF OPERATION | RATING PER CENT | LB. STEAM PER LB. COAL |
|---|---|---|---|---|---|
| Boiler No. 1.... | 41,400 | 355,500 | 24 | 164 | 8.60 |
| " 2.... | 36,500 | 627,000 | 24 | | Refuse |
| " 3.... | 57,800 | 500,100 | 24 | 174 | 8.65 |
| " 4.... | 60,300 | 519,500 | 24 | 181 | 8.63 |
| " 5.... | 55,300 | 491,200 | 24 | 227 | 8.87 |
| " 6.... | 7,600 | 66,500 | 4 | 184 | 8.69 |
| " 7.... | 43,300 | 377,100 | 24 | 174 | 8.71 |
| Total | 302,200 | 2,936,900 | 148 | 184 | 8.71 |

Water 3,480,000 Pounds — Average Economizer Temperatures

River Water Temperature H....L.... Flue Gas To..... Feed Water To 200

Atmospheric Temperature H 35 L 32 Flue Gas From... Feed Water From 265

| CONSUMPTION | STEAM CONSUMED | TONS PRODUCED | LB. STEAM PER TON |
|---|---|---|---|
| Digester No. 1 | 89,900 | 11 | 8,170 |
| " 2..... | 112,000 | 14 | 8,000 |
| " 3 | 123,100 | 18 | 6,830 |
| Bleach Plant | | | |
| Total | 325,000 | 43 | 7,560 |
| No. 1 Paper Machine | 39,200 | 2.340 | 16,700 |
| " 2 " | 139,500 | 15.715 | 8,800 |
| " 3 " | 171,000 | 18.793 | 9,090 |
| " 4 " | 114,100 | 10.601 | 10,750 |
| " 5 " | 91,200 | 7.574 | 12,030 |
| " 6 " | 191,000 | 36.245 | 5,280 |
| Total | 746,000 | 91.268 | 8,180 |
| Turbine | 873,200 | | |
| Paper Mill Total | 1,098,300 | | |
| Sulphite Mill Total | 360,300 | | |
| Total Consumed | 2,331,800 | | |

REMARKS: Turbine extraction Paper Mill 97,700 lb. Steam
Sulphite Mill 47,100 " "
Total 144,800 " "

H. W. GOCHNAUER,
Per M. V. C.
Plant Engineer

FIG. 3 SPECIMEN STEAM RECORD

and the steam consumed by the mill. The difference is the amount of steam used in the boiler plant, which averages about 8 per cent of the total production.

The boiler room is operated on three eight-hour shifts and the coal and steam records are kept for each shift.

Originally, a chart was plotted daily indicating the "pounds of steam per pound of coal" record obtained by each shift. In this manner, competition was set up, which benefited the efficiency of the boiler plant. However, it was found that some of the men became careless about depositing the weigh cards, which produced an unfair situation and, more important, ruined our records. It was found that the best boiler effi-

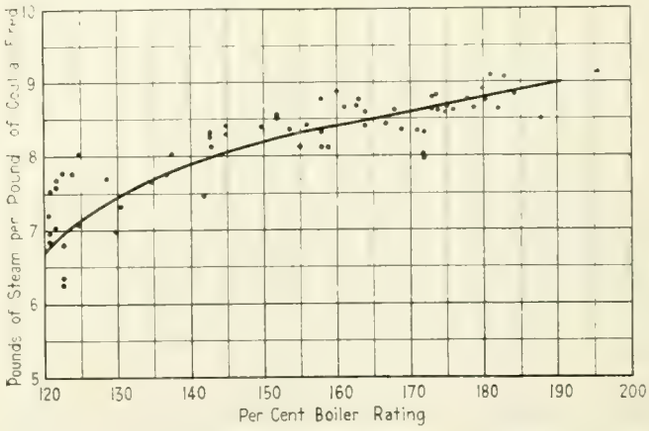



FIG. 4 RELATION OF STEAM CONSUMPTION AND BOILER RATING

ciency was obtained with a rating of about 175 per cent and so "boiler rating" was substituted for "pounds of steam per pound of coal" on the chart.

This change removed the desire for recording incorrect weights and at the same time produced constructive competition. The chart, Fig. 4, shows tests of boiler rating and its bearing on efficiency of operation. This was made up from actual daily records.

Coal is an important factor in the manufacturing of paper and its purchase, storing, handling and consumption should have the best constant attention.

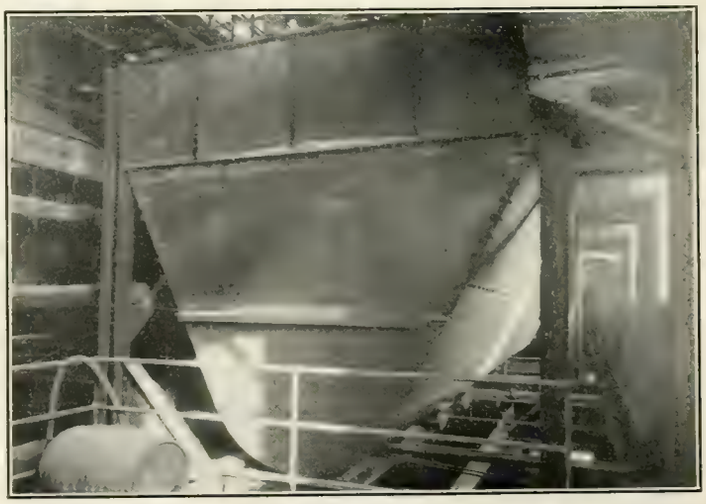


FIG. 5 OVERHEAD COAL BUNKER, 100 TONS CAPACITY

# Relation of Safety and Production

## Practice of Edward G. Budd Manufacturing Company

By ROBERT H. LUCKENBACH

Safety Engineer, Edward G. Budd Manufacturing Company

IN the August, 1925, number of this magazine appeared an interesting article entitled "Real Safety Movement to Come." The writer brought out a number of vital points concerning the importance of safety in American industry, particularly emphasizing the need of executive interest and acceptance of responsibility.

In this paper, the writer has endeavored to emphasize some of the important points which have assisted in improving the safety of the plant with which he is connected, and which are in line with the policy of the one previously printed.

Industry has had many years of development, and it is remarkable how great have been the strides of improvement in machinery and equipment to simplify and short-cut the methods of production, so that the ultimate product may be placed upon the market at a lower cost. Safety does not have so many years to its credit as industry, and it is reasonable therefore to think that there must still remain a wide field for improvement.

Many manufacturers have carried safety work parallel with their other industrial development by including the factor of safety in their calculations of what production should be received from their machinery. The man who operates the equipment is equally as important as the machinery, and to protect him will enable him to give more valuable service to his employer. Our safety endeavors should therefore run parallel to the industrial, and not be considered as a remedy to be taken only during an accident epidemic.

With the industry established on a firm foundation, and in consideration of the relation of safety to industry, the management is called upon to bear the responsibility of the safety of its employees. The establishment of a safety division in a plant should be considered equally as important as the treasurer's department or the sales department, for accidents will make their dent in both production and finance, despite the fact that this is often overlooked.

Nearly all machinery is dangerous. Revolving fly wheels, belts, etc., are all hazards, and while they may be covered with guards for protection, they are not always kept in this condition, and offer a possible hazard at any time. The "point of operation" is nearly always open for the necessary work to be accomplished by the machine. Hazard is therefore always present.

All machinery must be fully guarded to avoid coming in contact with moving parts. The removal of these guards for any purpose other than repairing the machine, except in a very few cases, is a serious offense, as it subjects some unfortunate workman to injury that he should never receive. A guard should be considered carefully from an engineering standpoint just as much as the expected tonnage from a large power press or the production per hour. A guard well made and properly applied becomes an asset, but a cheap temporary affair is a dangerous liability, and often offers a worse hazard than none at all.

After a certain time men become so accustomed to machinery that they will let down in their fear of an accident from it, and become more daring while operating or caring for the machinery, and climb about

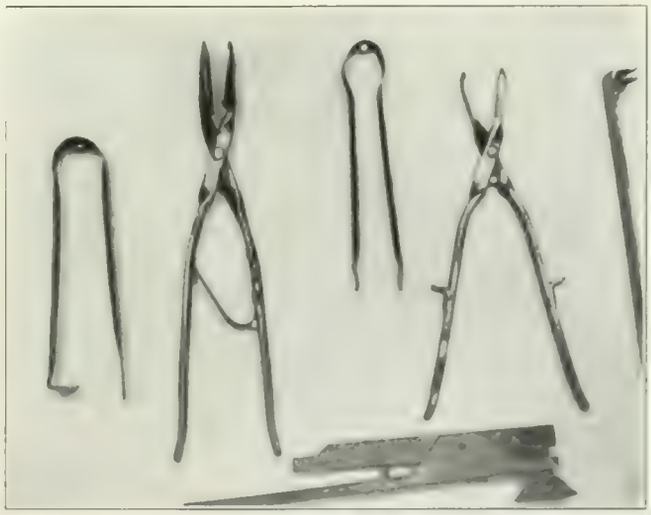


FIG. 1 SAFETY TOOLS FOR SAFE OPERATION OF PRESSES

or operate these moving parts with a feeling of security which, considering their years of experience, excuses them somewhat but does not protect them from possible injury. This becomes a serious problem, for these men are subjecting themselves to dangers they should not be exposed to, and sooner or later the inevitable happens.

In addition to the hazard of the common handling which is necessary at all plants where sheet metal is used in large quantities there is in our plant, as well as many others, a hazard feared by many, the punch press. It seems to be the general opinion that presses are more dangerous than most machines, but it has been our experience that if employees are properly

trained in the safe operation of presses, and the instructions given by the safety department are carried out, accidents from presses are reduced to a very small number.

Where the piece of steel to be formed has sufficient flange or projection so that the hands do not come too close to danger points, and under certain conditions where presses have long slow strokes, safety tools are not required, but in every other case it is essential that safety pliers, suction feeders, hooks, etc., must be used. The fingers and hands must not be placed under the die when placing a stamping on the die or while taking it out. We instruct our men in this manner, and do not feel justified in risking their fingers and hands in having them depend upon special devices to push their hands out of danger before the ram of the press descends.

Fig. 1 indicates a few of the safety tools necessary for safe operation of our presses. Fig. 2 illustrates the most dangerous manner in which to feed the die. The failure of a clutch or brake, or the thoughtlessness of an operator who trips the press too soon will surely cause an accident. But if the safety tools are used as in Fig. 3 there is no danger of accident to the man's fingers. Due to the particular style of die necessary and the number of different dies which must be changed daily, we have also found that point of operation guards are not applicable. Fig. 4 illustrates what happens to safety tools and devices when the press is tripped too soon or by mistake. The gruesome truth is self-evident. Fingers could readily have been cut off in place of these tools, but the safety rules are observed and accidents averted.

It is also an essential production and safety feature to keep all machinery in perfect working condition. All parts should be carefully inspected and loose or defective parts repaired or replaced. Guards should be kept in place at all times. Even with all the careful inspection and repair of machinery some of the possible dangers are not removed. The clutch mechanism may fail at any moment or the brakes may work loose and permit the ram of the press to descend suddenly. Bolts work loose on parts of the press overhead or even in the dies and in falling from their place cause serious injury.

The careful design of dies from a safety standpoint is another important item in connection with press work. Sections of dies may be cut away to provide room for the hands of the operators or for the use of a special shaped tool to remove the finished piece from the die. In some cases dies may be equipped with gate guards which close down in front of the point of operation before the ram descends to form the piece, but usually this guard offers a hazard in itself and we seldom use this type of safety appliance. Complete permanent enclosures of dies may be used where possible if desired, and chutes or automatic feeds can be attached to assist in safely operating the press, and in many cases increase the production.

Eye protection in industry is as necessary as protection to the fingers and hands and owing to the simplicity of bringing about this protection every organization should have little or no eye difficulty. There are some excellent goggles, shields, etc., on the market today, and if the safety organization insists upon their use in connection with the various hazards the eye injuries can be reduced to a very small number. Many of our employees can smile in the face of the possible loss of an eye as shown in Fig. 5, which was taken from a *bona-fide* case.

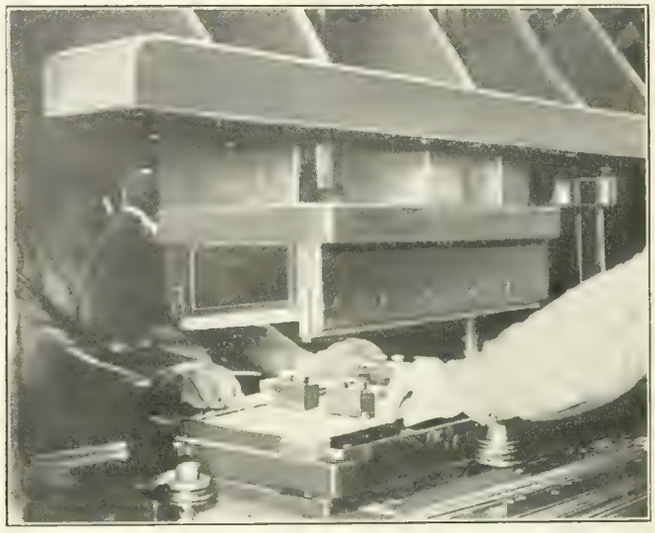


FIG. 2 MOST DANGEROUS MANNER IN WHICH TO FEED A PUNCH PRESS DIE

All operations of grinding, polishing, chipping, spot welding, hand-snipping, etc., require the use of goggles, and good goggles properly fitted, with compulsory measures that they are worn, is a sure cure for eye accidents.

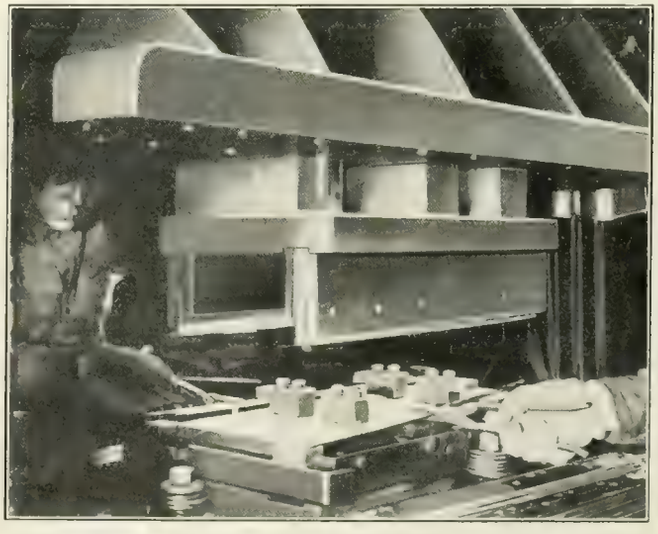


FIG. 3 USE OF SAFETY TOOLS PREVENTS ACCIDENTS TO THE FINGERS

Men who are to be responsible for the accident experience of a plant should be chosen with care just as the management would select a cashier or production manager. A manufacturer was once heard to say, "Well, yes, we do require a safety man. Let's see, there is old Jim Jones, who has been around here for

jobs doing odd jobs in the office and shop, we can make him our safety man." The success of safety in this plant will not cause much interest and the man himself will be worse off than in his old job. A man with experience, personality and good judgment is the man who will make the safety movement a success, and with the complete co-operation of the management, there is but little doubt of the ultimate result.

Forced production has been blamed many times for accidents and in some cases justly, but there is no really good reason why production and safety should not run parallel with each other, for without safety, production would be horribly crippled. Those directly in charge of production should be in close harmony with the safety movement for it is but natural at times to feel that the man on a machine is but a tool or spoke in a wheel. The great tragedy of the question seems

FIG. 4. DAMAGED SAFETY TOOLS AND DEVICES

to be that production in its mad rush to do the nearly impossible loses thought of the fact that workers are human. Everyone of them represents the spark of life which should be protected and nurtured so long as possible for we are here only a short time at the best.

To amplify and illustrate the subject, the writer selected a few photographs, reproduced herein. These represent the general practice of this organization to make a safe plant for the employees.

The product is difficult stampings, principally automobile bodies, of the all-steel full-vision type. Our management is very proud of its product, and also proud of the fact that safety is one of the important features in the construction of "Budd" bodies, both for the user and for the employees within our walls.

A good reason can nearly always be found for an accident. There is always a real cause for it and one rarely "happens" simply from some mysterious, inevitable reason. Everyone is sympathetic and doubly interested at the time an accident happens, and the origin of the trouble should be traced at once so as to prevent its recurrence. If these small details are forgotten, when the excitement is over, the accident is soon forgotten, and so is the origin and cause of the accident. The safety organization should boil the entire situation down in order to trace the cause and correct the [illegible] with thoughts of the future.

There are a large number of hazards connected with other phases of industry such as the loading of shop trucks, piling of material about the factory or in storage, and considerable progress can be made in preventing serious accidents from this source. Good housekeeping in a factory, no matter how large or small, is a very important feature of safety work. Neatness and cleanliness of the floors, locker room, machinery, halls, etc., present a good appearance and create a certain satisfaction to both management and employees.

At the Budd plant, each safety adviser is held responsible for his particular division of the plant, or group of departments, as to their accident experience. It is his duty to study the various operations and decide where safety devices are required, and to enforce their use.

He reports daily to the Safety Department head and when safety rules have been ignored or disobeyed, a report is sent to the head of the department where infractions have been made and a copy to the works manager. This makes it possible for the management to keep in close touch with the progress of each department. A monthly report is then issued, giving the total number of offenses for each department. This is posted upon the bulletin boards with the man's number, under the name of his foreman or department head so that everyone may see what each department is doing toward safety. The form of the daily report is shown in Fig. 6 on the following page.

The safety advisers are trained to know every operation, and are capable of suggesting safe methods of operating the machinery. They are fully capable of

FIG. 5. USE OF GOGGLES STOPPED EYE INJURIES IN A VISE SHOP NEARBY

actually running the job so as to prove to the employee that the work may be accomplished safely and many times with less physical energy. When the worker realizes that a safety man can operate the machinery himself, his respect for safe practice is multiplied considerably.

During the year 1924, our total loss time of days was reduced 67 per cent from the total of 1923, and

**DEPARTMENTAL SAFETY REPORT**
**Edw. G. Budd Mfg. Co.**

DATE

**DAILY ADVICE TO FOREMEN**

DEPARTMENT LOCATION

GENERAL FOREMAN SUB-FOREMEN

| | | | | |
|---|---|---|---|---|
| MUSHROOM TOOLS | | | | |
| TOOLS WITH BROKEN HANDLE | | | | |
| NON-USE OF SAFETY TOOLS | | | | |
| CARELESS OPERATION OF PRESS | | | | |
| REMOVAL OF GUARDS | | | | |
| NO JACKS USED | | | | |
| FAULTY BRAKES | | | | |
| AISLES BLOCKED | | | | |
| CRANE LOADS — Bad Chain | | | | |
| CRANE LOADS — Bad Sling | | | | |
| CRANE LOADS — Load not Chained | | | | |
| CRANE LOADS — Load not Guided | | | | |
| CRANE LOADS — Non-use of Bell | | | | |
| GOGGLES | | | | |
| APRONS (burlap bags, etc.) | | | | |
| STAIRWAYS — Blocked | | | | |
| STAIRWAYS — No Light | | | | |
| FIRE DOORS BLOCKED | | | | |
| OVER-LOADED TRUCKS | | | | |
| NON-USE OF HORN ON ELECTRIC TRUCKS | | | | |
| CRIPPLED TRUCKS | | | | |
| CARELESS HANDLING OF TRUCKS | | | | |
| UNCHAINED LOADS | | | | |
| PILING MATERIAL | | | | |
| UNCHAINED GAS TANKS | | | | |
| CARELESS HANDLING OF GAS TORCH | | | | |
| FOOLING OR THROWING MATERIAL | | | | |
| SMOKING | | | | |
| INFLAMMABLE MATERIAL | | | | |
| REMARKS | | | | |

Safety Advisor, SAFETY DEPARTMENT

FIG. 6 DEPARTMENTAL SAFETY REPORT
(Actual size 8½ in. x 11 in.)

we know that the efforts of the safety department, together with the co-operation of the workers and their foremen is largely responsible for this reduction.

As far as can be estimated at the present time, 1925 will not exceed the time lost in 1924, and with this in mind, the safety department feels confident that even further reduction can be made in the year to come.

The three vital points which seem to bring about best results in safety organization are instruction, co-operation and penalty. A new employee must receive the proper instruction as to the safe practice in operating the machinery or in accomplishing the particular job to which he has been assigned. This instruction must be checked up by the field man of the safety division and forgetfulness of the rules must be promptly corrected. The complete co-operation of the management is the first step necessary for safety success and the foreman directly in charge must fall into line and guarantee their personal support. Penalties are sometimes considered harsh and unreasonable, but they are essential to the success of safety. When it is necessary to carry the penalty so far as to discharge the employee, we feel that both the man and his family will be grateful for such drastic action, if they realize that the management have been interested sufficiently to protect him from injury by dismissing him from their employ.

Another important feature which helps to bring success in safety endeavor is personal contact with the employee. Those directly in charge of any department must realize that the majority of workers will accomplish better and bigger work if they are treated in a human fashion. It is true that a certain amount of respect and full obedience is always due the employer, but constant scolding, and harsh abusive language aggravates the employee, and many times produces a reverse effect. Treat him with fellowship, use a little extra time for instruction, and invariably he will be won for safety as well as production.

## "Please Clean This Car."

THE Shipper's Advisory Board, composed of shippers working in co-operation with the railroads throughout the country, is sponsoring the campaign for the better cleaning of freight cars at destination. The Buick Motor Co. has taken the lead in this movement by placing on all carloads of automobiles shipped a card reading as follows:

PLEASE CLEAN THIS CAR

So far as is possible please remove all blocking, dunnage, nails, etc. from this car. It will help in getting the car back to the factory quicker and in better condition.

While there may be some question as to just who is legally responsible for the cleaning of freight cars, the Buick Motor Co. has taken the position that all consigners can materially assist the movement of empty cars back to the shipping territory if they will give attention to the cleaning of the cars at destination. If each receiver would attend to his own cars at the time of unloading, no particular hardship would be suffered by anyone.

If cars are not cleaned by the consignee it means that they are usually taken to some central railroad yard where, at a convenient time, the railroad people clean them, or in many cases the cars are brought back to the shipping factories with all the original dunnage left in them. This latter condition of course delays the placing of the car for loading and causes more or less inconvenience.

The Buick traffic department reports a very marked improvement in the condition of cars since the practice of placing these cards in the cars was adopted.

# Budgeting the Textile Industry

## How to Establish a Budget

By CAREY E. THARP

POSTWAR experience of the textile industry has been marked by rapidly expanding manufacturing facilities not justified by any corresponding increase in the demand for textile materials. As a result, there has been a marked overexpansion, and an economic readjustment is inevitable, by which the weak will be weeded out and the stronger units will survive. The present intense competition has caused many concerns to show unfavorable results, and some individual mills must either change their operating methods, or else fall under the ban of the economic law. Quality and texture of fabrics is fairly well standardized, and the principal operating problem is to produce standard grades at a cheaper price than is done by competitors.

No textile treasurer desires to head the concern that may be eliminated in this competition. He is therefore more interested in affecting economies in operating methods than ever before. While he cannot make many mistakes, and is not inclined to jump hastily into new methods, he nevertheless desires to study suggestions carefully to see if new ideas are adaptable to his business.

One treasurer recently told the writer that he thought the budget, as applied to manufacturing operations, "was a lot of rot." "What would you do," he asked, "if your budget called for the purchase of so much cotton, and danger of overrunning would not allow you to take full advantage of a favorable market. Would you hold off buying until you could live within your budget?" I convinced him that a real budget would not work in that manner.

The textile budget is workable and economical. While it is not a panacea for all industrial ills, for such does not exist, the budget can be made the most effective link in a company's chain of internal control.

### Adapting the Budget to Internal Problems

In any concern, in any industry, the principal problems should be studied in conjunction with the fundamental uses that can be made of the budget. All functions for which a budget may be adapted cannot be introduced into any one company, but some of these functions can be adapted to advantage to any given industrial problem in such a way as to justify beyond doubt the additional cost. The following, in condensed form, is a budget classification, suggesting various ends that may be gained by different uses:

I. Income Budget.
   1. Sales (by classes of products).
   2. Miscellaneous income.

II. Disbursements Budget.
   1. Operating expense (by departments).
   2. Purchase of raw materials.
   3. Additions to plant.
   4. Accounts, notes or bonds payable.

III. Quantity Budget.
   1. Sales (by products).
   2. Manufactured goods inventories.
   3. Production.
   4. Raw material inventories.
   5. Raw material purchases.

The budgets have these fundamental functions:

1. *Determination of Financial Position.* A careful estimate of income and expenditures, and periodic statements showing a comparison of actual performance with these estimates, will enable the planning ahead of expenditures, and provision of cash to meet expected requirements.

2. *Economies in Operating Costs.* A budget sets standards of expenses for operating units, basing these standards on past trends of expenses and the estimated future production.

3. *Stabilization of production through Forecasts of Sales.* An organization that experiences wide fluctuations in the volume of sales during short periods of time must either forecast these fluctuations, or allow production to fluctuate in similar fashion. The latter policy is especially expensive, as it increases labor turnover through failure to provide steady employment.

4. *Definition of Responsibility.* Each executive should know definitely the extent of his authority and responsibility.

5. *Planning Policies.* Planning ahead of definite policies toward inventories, raw material purchases, and additional machinery.

In general, the textile industry has two main problems that can best be served by a budget, although problems vary with individual mills. These are:

1. Reduction of operating costs.
2. Funds available for meeting obligations.

Stabilization of the volume of production is sometimes a third problem. When seasonal movements are eliminated, however, production is usually fairly stable although it may be chronically dull over long periods of time.

The first step in establishing a budget should be to study carefully the problems of the particular mill, and having determined the most important problems, to adapt budget organization to their solution.

## RELATION OF INTERNAL ORGANIZATION TO BUDGETARY CONTROL

The writer uses a rather large plant for purposes of illustration. The manufacturing unit is divided into eight mills, all at one location, each specializing in one type of product, but some producing goods in common with other of the mills. The treasurer is general manager. Directly responsible to him are the selling agent, manufacturing agent (herein termed the agent) and comptroller, heads, respectively, of the sales, production and finance departments. This organization is charted in Fig. 1.

The treasurer heads the budget. Due to the volume of detail required in supervision, however, he has assigned all detail work to a staff assistant, herein termed the budget director. The treasurer reserves for himself final approval of all estimates, and serves as a supreme court, whenever necessary, to settle differences of opinion between the budget director and the executives who operate under the budget. Any question may be referred to the treasurer, acting in this capacity, by any of the parties mentioned above. This virtually limits the authority of the budget director upon fundamental matters to persuasion by facts and reasoning that his point of view is correct. If he fails to "sell" his point of view to division heads, his recourse lies in carrying his point with the treasurer by the same means.

The exact position of the budget director in the organization is unimportant. The function may be exercised by the comptroller, or by an assistant to the comptroller. It is fundamental, however, that close supervision of budget policies and results be retained by the general manager, otherwise the budget will suffer from a lack of prestige. Results can be accomplished most easily by direct contact between the budget director and the general manager.

The following duties, illustrated below in this paper, represent the principal duties of the budget director:

1. Compilation of estimate data.
2. Checking the accuracy of estimates.
3. Establishment of budget procedure.
4. Extension of scope of the budget.
5. Final approval of expense divisions.
6. Compilation of periodic budget results.
7. Analyses of budget performance, and comments of corrective and constructive value thereon.
8. Compilation of budget system book.[1]
9. Forecast of company's general business.
10. Diffusion of budget information.

Budget divisions are made according to lines of authority and responsibility. Each executive is budgeted only for those activities for which he is directly responsible. In Fig. 2, for example, operating expenses are divided between the agent, selling agent and comptroller, depending on which is responsible for the outlay. Each of these, in turn, must hold subordinates responsible for good or bad results on subdivisions; consequently, each has his budget so subdivided that performance can be traced to the ultimate superintendent, overseer or sub-department head responsible therefor.

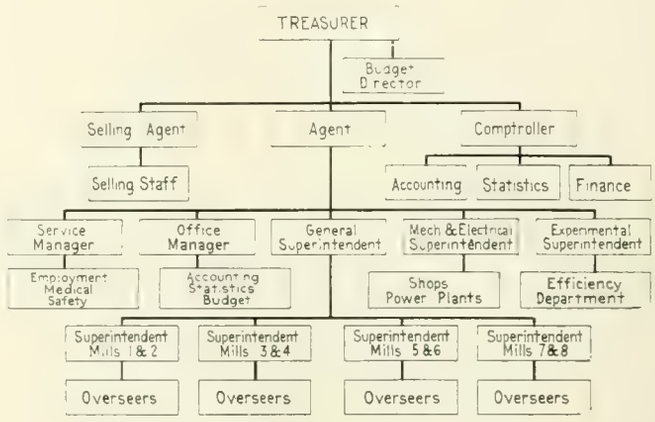



FIG. 1 GENERAL ORGANIZATION CHART

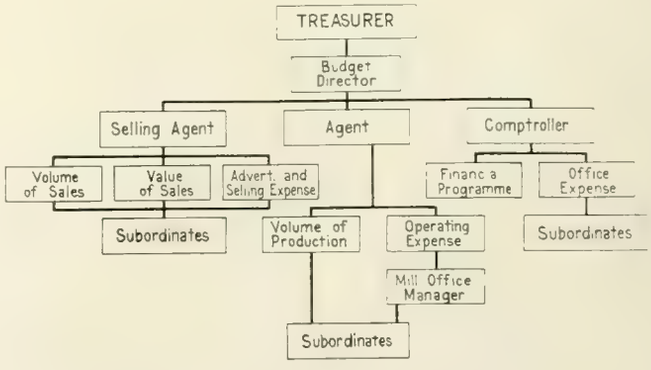



FIG. 2 LINES OF AUTHORITY FOR BUDGETARY CONTROL

Budgeting according to lines of responsibility also means that overhead should be budgeted at the source. For example, a mill superintendent is not responsible for the amount of insurance, taxes and depreciation that is charged against him for accounting purposes, and should not be budgeted for them, as he cannot possibly reduce any of them in amount, no matter how much he might try. To this extent, an expense

[1] A budget system book crystallizes all rulings, organization, procedure, etc., pertaining to the budget. A detailed description of its contents will appear in the next paper.

budget should not coincide with accounting charges: the budget and the accounts could represent the same amounts of money in total, but distribution of this total according to responsibility is different from distribution according to accounting theory.

The agent may find it necessary to confer detailed supervision over his budget upon some subordinate, due to its size, and to the amount of time involved in keeping up with budget performance. Frequently this function can be exercised by the mill office manager.

### Selling the Budget to the Organization

The budget must be sold to the executives as it is being installed. A budget in which executives place no faith is worse than no budget at all. If executives are to believe in the budget, they must understand it. Their initial knowledge along this line is usually very limited, even though they may be experts in their own lines.

Two methods may be followed in selling the budget: first, to build up procedure simply and logically, proceeding from fundamentals to accessories, and passing to the staff knowledge of budget functions step by step as it develops; second, to force the budget down the throats of the organization, and depend on securing goodwill when results are shown. Needless to say, the second method is not likely to succeed, because co-operation of the operating executive is usually a prerequisite to successful results. Some concerns, however, report satisfactory budgets developed in this manner. The first method is conducive of far better results, for it is easier to hold goodwill, than to tear it down and build it up again. The method of developing a budget shown below is a suggested means of creating goodwill for the budget as it develops, and of securing co-operation in the task of making it a success.

**BUDGET ESTIMATE**

Mill No. 4

| | DEPT. | PREVIOUS EXPENDITURES 1922 | 1923 | 1924 | AVERAGE | ESTIMATE 1925 | REMARKS |
|---|---|---|---|---|---|---|---|
| Weaving | | | | | | | |
| Mechanical labor | | 1,430 | 1,886 | 1,972 | 1,762 | | |
| | | 2,455 | 2,721 | 1,811 | 1,669 | | |
| Total | | 2,885 | 3,607 | 3,753 | 3,431 | | |
| Machine operation | | 4,208 | 4,608 | 4,524 | 4,457 | | |
| | | 4,379 | 4,216 | 4,446 | 4,347 | | |
| Total | | 8,587 | 8,824 | 8,970 | 8,804 | | |
| Repair expense | | 1,154 | 827 | 740 | 907 | | |
| | | 880 | 801 | 914 | 865 | 910 | |
| Total | | 1,954 | 1,628 | 1,654 | 1,772 | | |
| Indirect labor | | 10,884 | 11,487 | 12,477 | 11,616 | | |
| | | 12,569 | 11,467 | 11,430 | 11,822 | | |
| Total | | 23,453 | 22,954 | 23,907 | 23,438 | | |
| Less: Department Budget | | 17,681 | 17,209 | 18,229 | 17,706 | | |
| | | 18,772 | 18,000 | 18,427 | 18,356 | | |
| Total | | 36,453 | 35,209 | 36,656 | 36,062 | | |

Fig. 3 Budget Estimate

Note.—The principal purpose of semi-annual subdivisions is to provide additional information for semi-annual estimates. When estimates were placed on an annual basis, semi-annual division of past expenses was discontinued.

### Procedure in Installing a Budget

An outline of the theory and mechanics of installing a budget system is given below. It is principally illustrative, for no budget can be built upon an iron-bound formula, and no two budgets would work exactly alike. It shows a method that works in one company, however, and suggests that principles therefrom are adaptable to advantage elsewhere.

The writer began installation of a textile budget system in June, 1924. In analyzing the possible order of procedure he decided that internal problems would best be served, if he developed budgets in the following order:

I. Expense Budget.[2]
   1. Expenses not affected by the rate of production.
   2. Expenses affected thereby, but not in direct proportion thereto.

II. Quantity Budgets.
   1. Volume of sales.
   2. Volume of manufactured goods inventories.
   3. Volume of production.
   4. Volume of raw material inventories.
   5. Volume of raw material purchases.

III. Income Budgets.
   1. Sales (By classes of products).
   2. Miscellaneous income.

IV. Disbursements Budgets.
   1. Purchases of raw materials.
   2. Additions to plant.
   3. Operating expenses that fluctuate in direct proportion to the volume of production.
   4. Accounts, notes or bonds payable.

The fiscal period of the budget was eventually to be one year, corresponding to the calendar year. In order to benefit by additional practice, however, we decided to have shorter budget periods for 1924 and 1925.

Since the first installation was to be an expense budget, we decided to begin on the treasurer's office, which included the general office and the selling department. This would enable us to experiment as much as possible on ourselves, before extending it to

[2] Solution of the various problems of sales association regarding [illegible] is obviously the first step in any budget. This [illegible] problem is likely to continue so. And presents no problem requiring pressing solution. We therefore defer work on an income budget until expense budgets are developed.

the mill departments. It is also the easiest place to begin, since general office expense does not fluctuate with changes in the volume of production to any great extent, and we could assume with safety, in setting our standards, that changes in production would not upset our estimates.

The first problem in developing any budget is to determine a fair standard of expense for some future period of time, basing it on past expenses for corresponding periods and special knowledge of future requirements. The second problem is to make periodic comparisons of actual performance with this standard. Third, it is necessary to ascertain causes for deviations of actual performance from the standard.

We drew off from accounting records expenses by semi-annual periods for the previous three years, using expense classifications shown on the accounts. The grouping shown therein did not always give an ideal subdivision, because it was originally subdivided more for accounting convenience than for purposes of control. It was easily accessible, however, and was satisfactory as a beginning. The comptroller and the selling agent were given budget estimate forms (similar to Fig. 3) showing past expenses of their respective departments, and were asked to prepare estimates for the second half of 1924 from three viewpoints.

1. What figure would be consistent with the trend of past expenses?

2. What extraordinary expenses will occur during the new budget period that were not experienced in previous periods?

3. What extraordinary expenses have occurred previously that will not recur during the forthcoming period?

Of course, these three points of view could not be covered completely for the first estimates. Experience only would indicate all the extraordinary expenses of a business. A sufficiently thorough review can be made, however, to produce a standard that parallels approximately the normal future performance. Additional experience would reduce the element of error in estimates caused by incomplete data.

When estimates were completed, the budget department checked their accuracy, basing its calculations upon the above point of view. We did not request a change of figures unless the original estimate furnished us varied considerably from our check. While we made every effort to determine a truthful forecast of expenses, we did not desire to establish too rigid standards at first. We preferred to have executives thoroughly satisfied with original forecasts, and depended on putting teeth in the budget machinery at some future date, when procedure would be somewhat crystallized.

Having established fairly satisfactory estimates for the head office, we decided to budget immediately

**MONTHLY BUDGETARY CONTROL**

Mill No. 4 (Continued) Page 14

4 WEEKS ENDING August 29, 1925

| EXPENSE DIVISION | DEPT. | AUGUST 1925 Actual Expense | AUGUST 1925 Budget | AUGUST 1925 Over or Under $* | AUGUST 1925 Over or Under % | JAN.–AUG. 1925 Actual Expense | JAN.–AUG. 1925 Budget | JAN.–AUG. 1925 Over or Under $* | JAN.–AUG. 1925 Over or Under % | JAN.–AUG. 1924 Actual Expense | JAN.–AUG. 1924 Budget | JAN.–AUG. 1924 Over or Under $ | JAN.–AUG. 1924 Over or Under % | Annual Budget |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Warping* | 15 | | | | | | | | | | | | | |
| *Mechanical labor* | | 89 | 108 | | | 1,189 | 916 | | | 990 | | | | 1,400 |
| *Machine supplies* | | 22 | 60 | | | 745 | 800 | | | 853 | | | | 1,100 |
| *Room supplies* | | 60 | 16 | | | 115 | 282 | | | 330 | | | | 550 |
| *Indirect labor* | | 174 | 246 | | | 2,108 | 2,492 | | | 2,649 | | | | 3,600 |
| *Total* | | 345 | 430 | 85 | 20 | 4,357 | 4,510 | 153 | 3 | 4,731 | | | | 6,450 |
| *Tying in warp* | 16 | | | | | | | | | | | | | |
| *Mechanical labor* | | 81 | 92 | | | 616 | 784 | | | 631 | | | | 1,200 |
| *Machine supplies* | | 3 | 38 | | | 255 | 326 | | | 245 | | | | 450 |
| *Room supplies* | | 31 | 44 | | | 251 | 373 | | | 324 | | | | 570 |
| *Indirect labor* | | 305 | 248 | | | 1,638 | 1,997 | | | 2,004 | | | | 9,320 |
| *Total* | | 370 | 422 | 52 | 8 | 2,760 | 3,430 | 670 | 20 | 3,203 | | | | 11,540 |
| *Weaving* | 17 | | | | | | | | | | | | | |
| *Mechanical labor* | | 182 | 174 | | | 1,785 | 1,958 | | | 2,124 | | | | 3,000 |
| *Machine supplies* | | 778 | 962 | | | 4,132 | 4,524 | | | 5,670 | | | | 6,900 |
| *Room supplies* | | 246 | 126 | | | 2,251 | 2,092 | | | 2,002 | | | | 3,200 |
| *Indirect labor* | | 1,456 | 1,576 | | | 13,117 | 14,110 | | | 14,168 | | | | 21,600 |
| *Total* | | 2,362 | 2,438 | 76 | 3 | 21,285 | 22,684 | 1,399 | 6 | 23,954 | | | | 34,700 |
| *General mill expense* | | 178 | 154 | 24 | 17 | 1,346 | 1,162 | 184 | 15 | 1,221 | | | | 1,850 |
| *Mill clerks* | | 182 | 218 | 36 | 17 | 1,789 | 1,874 | 85 | 5 | 1,852 | | | | 3,750 |
| *Grand total No. 4 mill* | | | | | | | | | | | | | | |
| *Mechanical labor* | | 604 | 708 | 104 | 14 | 7,180 | 7,316 | 136 | 2 | 7,204 | | | | 10,500 |
| *Machine supplies* | | 916 | 1,120 | 204 | 19 | 11,564 | 11,240 | 324 | 3 | 12,346 | | | | 16,300 |
| *Room supplies* | | 214 | 612 | 398 | 65 | 5,634 | 5,494 | 140 | 3 | 5,775 | | | | 8,240 |
| *Indirect labor* | | 2,530 | 3,140 | 610 | 18 | 31,726 | 37,182 | 5,456 | 15 | 36,711 | | | | 63,740 |
| *General mill expense* | | 178 | 154 | 24 | 17 | 1,346 | 1,162 | 184 | 15 | 1,234 | | | | 1,850 |
| *Mill clerks* | | 182 | 218 | 36 | 17 | 1,789 | 1,874 | 85 | 5 | 1,942 | | | | 3,750 |
| *Total* | | 4,624 | 5,952 | 1,328 | 2 | 59,239 | 64,268 | 5,029 | 8 | 65,212 | | | | 104,380 |

* Note:—Overexpenditures are shown red; underexpenditures, black.

FIG. 4 MONTHLY BUDGETARY CONTROL SHEET

some of the easier mill departments. Logical next steps were the extension of our efforts to the mill office and the service department. Both were essentially non-operating in character and neither had many expenses that fluctuated very much with changes in the volume of production. We desired, in addition, to establish immediate contacts with the operating mill executives. The mechanical and electrical engineer seemed to be the best choice as an opening wedge. He was a young engineer, progressive in thought, who viewed new ideas in an experimental light, and who was certain to give the budget a fair trial. These three executives were given a brief outline of the purposes of the expense budget and its ultimate scope at a conference, and as a result, they desired to give it a trial.

### EXPENSE SUBDIVISIONS

Further conferences with each resulted in the establishment of a tentative list of expense subdivisions. Expenses should always be so divided that each executive can trace good or bad performance to the ultimate subordinate responsible for it, or to departmental conditions that account for it. A careful classification of expenses is of obvious importance, since it constitutes the fundamental guide posts of an expense budget. We tried, in developing expense divisions, to diffuse two points of view: first, that each operating executive should have any expense subdivision that would facilitate a ready control on his part, and that discretion lay mainly with him as to the method of subdivision. Second, we could furnish an executive any information desired, but too elaborate information means high clerical expense, and we did not want to build up a costly record system. Consequently each executive was expected to bear in mind the interests of the company as a whole; and in case information was wanted additional to that shown on the Assembled Charges, he was asked to weigh its value to him against the additional cost of obtaining it.

We prepared budget estimates similar to Fig. 3, to cover the last six months of 1924. Mill executives were shown the method of estimating used in the head office, viz., basing estimates on (1) average of past expenses (2) unusual additions thereto, and (3) unusual deductions therefrom. They were also asked to ignore for the present any effect that fluctuations in the volume of production would have on the size of expenses. Later, we expected to develop means of forecasting production and of setting standards of expense covering all mill operations, for any given rate of production. The initial budget, however, operated on the assumption that there would be an average volume of production during the budget period, that previous expenses as a whole were incurred on an average volume of production, and therefore roughly accurate results on indirect expenses could be obtained by ignoring fluctuations in the volume of business.

Our initial attitude toward the volume of production was crude, but it had one distinct advantage. executives derived additional educational value through following our solution of a fundamental problem connected directly with their end of the budget. As the method of setting expense standards developed, their knowledge of budget methods would be grounded on fundamentals.

After one month's results under budget operations were available, we sent each executive a tabulation of his performance on a form similar to Fig. 4. This shows three comparisons: (1) current month's expense, compared with a month's share of the budget, (2) cumulative expense for the budget period, compared with a pro-rata share of the budget, and (3) cumulative expense for the current year, compared with the corresponding figures for the previous year. This furnished the necessary information for an analysis of budget performance. To illustrate by use of Fig. 4 (which represents the performance of a manufacturing unit during August, 1925) we note that Department 46, of Mill No. 4, spent $52, or 8 per cent less than its budget during the month, and that cumulatively it is $670, or 20 per cent underexpended. The cumulative expense is also $443, under the corresponding expense for the previous year; and assuming that production has not fallen off materially, the current budget shows the results of careful supervision. A copy of the Monthly Budgetary Control is sent through the organization to the executives responsible for performance, together with a comment letter analyzing results shown therein. This tabulation and its analysis constitute our basic control over budget performance.

At this stage, executives asked numerous questions as to how the budget would work under various contingencies. We therefore thought it expedient to write a preliminary exposition of theory and procedure for distribution among all executives of the company. This paper had four divisions: (1) Purposes of the budget, (2) By whom operated, (3) How operated, and, (4) Data and reports. The third heading described the way that the budget works, and took up every problem that we thought would confront an executive, illustrating by reference to the manner in which a family budget would work under the same conditions. This is given below, in condensed form:

### ANALOGY BETWEEN FAMILY AND COMPANY'S BUDGETS

*Purpose.* The [illegible] that the [illegible] rates of money over some [illegible] of the mill [illegible]

[illegible] budget is supported by a steady income it does not [illegible] that the company's income continue at a fairly even level, as in the past. This analogy therefore takes past expenditures as an indicator of the size of future expenditures. If future conditions of the company should change radically, the budget might [illegible] past expenses.

*Classification of expenses.* If a department head were [illegible] expenses under the main headings in which they would fall, for instance, rent, groceries, clothing, etc. Likewise, in budget[illegible]

He should analyze tentative subdivisions, to see if the information shown by them is that which carries the maximum meaning to him.

*Amount of past expenses.* The second step, in establishing a family budget, is to determine as accurately as possible what has been spent in the past, both in total, and for each of the classes of expense. With this point in mind, the next step in the department budget is to receive figures covering past operations, which will enable him to measure future requirements. These figures will be compiled by the budget department.

*Estimate of future expenses.* Estimates, in a family budget, would be based primarily on the run of past expenses. To this one would add the cost of extraordinary items not experienced previously, and deduct the cost of expensive items previously purchased, but which would not be repeated during the new period. For instance, it might be necessary to purchase a new overcoat during the coming period, which is an extraordinary addition to the normal clothing budget, and he might have moved his residence the previous year, which entailed charges that would not be experienced during the new budget period, and would therefore be a deduction from his former expense. The department head would use this method of procedure as a fundamental basis for making estimates.

*Daily control of expenses.* The next step in operating a family budget is to watch expenditures from day to day, to see that they come reasonably close to what should be spent. Likewise, in the department budget, the executive would have a daily control as his next step. This can be done by him in a crude way, which is nevertheless exceedingly valuable, by thinking in terms of his budget standard each time he authorizes an expenditure. Each month, when he receives the monthly budgetary control covering activities of the previous month, it will be easy for him to analyze his complete financial position to date.

*Seasonal expenses.* Suppose the family budget has apportioned $120 per year for coal, which is $10 per month, and actually spends $100 during September, because most of the year's supply is purchased during that month. Obviously, this fact in itself would cause no worry, for the entire outlay for coal over the year might be well within budget limits. Likewise, if the department head, after analyzing budget results, should find that on some expense subdivision he has exceeded his monthly allowance, his first question would be "Is this a normal outlay of money, due to the fact that a great portion of the expenditure for this item comes in one month, or have I spent too much money?" He can analyze this to his own satisfaction by reviewing the nature of the item to ascertain if it is seasonal in character, or if it would be spread normally in equal amounts over the months of the budget period. His main concern should be whether he is likely to spend more in the cumulative period covered by the budget than his standard indicates.

Other headings used for analogy were:
Need of Elasticity for Expense Divisions.
Nature of Expense Item.
Unforseeable Expenses.

## Budgeting Manufacturing Expenses

We contemplated introducing the expense budget, to some degree, in every manufacturing department, before the end of the year. Budget organization, here, as in other units, should be such that responsibility can be traced to the ultimate employee responsible for performance. Fig. 1 shows the following general organization:

1. General Superintendent.
    A. Four Mill Superintendents, each supervising two mills.
        (1) Department Overseers.

Complete allocation of responsibility could be accomplished by the following budget organization:

1. Summary of total expenses for Manufacturing.
    1. Summary of Expenses for Mills 1 and 2.
        A. Expense of Mill 1.
            (1) Departments 11 to 19 inclusive.
            (2) General expense.
        B. Expense of Mill 2.
            (1) Departments 21 to 29 inclusive.
            (2) General expense.
    2. Summary of expenses for Mills 3 and 4, etc.

Having determined a general means of allocating responsibility, our next step is to create expense classifications for the manufacturing department, the unit of the overseer, or the ultimate executive responsible for expenses. The following general division of manufacturing expenses (exclusive of fibre) suggested itself:

1. Direct manufacturing expense (95% piece work).
2. Indirect manufacturing expense (time work).
3. Machine repairs.
4. Room supplies.

We chose the last two items as the field of our initial budget, because they represent expenses that are largely controllable by mill supervisors, although they are also affected by the volume of production. We prepared estimate forms covering past expenses, and divided expense of each department between (1) Mechanical Labor, (2) Machine Supplies, and (3) Room Supplies. Mill superintendents made estimates for the last four months of the year, which were checked by the budget department in the manner already described.

## Fundamental Advantages Gained

The most fundamental advantages gained during the initial budget period were (1) inculcating a general interest in ultimate ends to be gained, (2) in diffusing knowledge of budget routine, and (3) in paving the way for expansion into a unified system. Doubtless some saving was affected through conscientious efforts to show favorable results, but we regarded this as of secondary importance in the beginning.

Problems to be solved immediately were:

(1) Extension of budget scope to all expenses that are partially or wholly controllable by some executive.

(2) Establishment of estimates of the future volume of production, based on estimated volume of sales.

(3) Construction of a comprehensive system book, that would crystallize budget rulings and procedure.

(4) Determination of standards for each class of manufacturing expense, showing the amount of expenditure for any given volume of production.

These problems will be developed in the next paper to be printed in the February issue.

# Handling Products in the Squibb Plant

## Conveyors, Elevators, Lift Trucks, Spiral Chutes and Gravity Methods Used in a Most Effective Combination

By GEORGE E. HAGEMANN

*Associate Editor, Manufacturing Industries*

THE handling of materials in manufacturing is a problem which, for proper solution, must be considered separately and distinctly from the purely mechanical operations of processing. Nevertheless, when thus studied out, it must tie in directly at every step with the processing, so that routing is short, direct, as fast as the productive operations, and as simply performed as possible.

The new 13-story reinforced concrete building at the Brooklyn plant of E. R. Squibb and Sons, described in a previous article,[1] was laid out not only from a carefully conducted study of present and future processing requirements, but also with special and thorough attention to material handling as a distinct service intimately connected at every step with the actual making of products.

The material handling and process systems, as well as the general plans for arrangement and for co-ordinating the various activities of the plant, were worked out by the general superintendent and his associates.

While only one group of American manufacturers is engaged in the production of pharmaceutical and toilet preparations, yet the principles behind the study made and results accomplished are adaptable to practically every form of industry, and therefore may be of extensive use to many.

Future developments at the Brooklyn plant will call for a new manufacturing building across the street from the present new structure, to be served by a railroad siding. The streets surrounding the plant are too narrow to permit continuing the former practice of receiving and shipping all materials and products by truck. But as truck delivery is necessary at present, and always will be for local service in and out, an adequate receiving and shipping department, with ample covered platform space and room for trucks to operate without congestion on the property, was required.

Such a department has been installed in a building on the site of the future new structure. When the new plant is built, the shipping department will not have to be moved, for it is already located at just the position on the first floor which it must eventually occupy to best serve and be served by auto trucks and by freight cars on the proposed railroad siding.

Another location requirement for this department was that it should be at the point where it would have direct contact with the rest of the plant, to get materials into the manufacturing departments in the quickest and easiest manner, and to receive outgoing products from the order filling departments in practically a direct line.

In order to meet this necessity a large tunnel has been constructed under the street between the new building and the shipping building. This tunnel contains two Dow apron conveyor systems (see Fig. 1), the piping and conduits from the boiler room and the electric substation, and a passageway for the men working in the order filling and shipping departments. One of the conveyors is reversible and extends not only under the street but also beneath the floor of the new building, rising to the level at the far end by the elevators. See Fig. 2.

Fig. 1 Receiving and Shipping Conveyors Running Through Tunnel Under Street

Incoming materials received by truck or railroad in the receiving department are loaded on this conveyor, delivered to the space in front of the elevators,

[1] See December 1925 issue, pp. 939-42

piled on lift truck platforms, and moved to their respective storage points on floors above, where manufacturing processes originate.

The starting point of one of these processes is shown in Fig. 3. Bags of chalk are carried on lift trucks by means of elevators to the ninth floor where they are stored. As needed, these bags of material are

FIG. 2 DELIVERY END OF RECEIVING CONVEYOR

weighed on the scale and recorded. The contents are then dumped down the floor hopper and discharged into a sifting machine on the floor below. All lifting in rehandling is thereby avoided, and the material is stored where it does not take up room around machine processes. The hopper has a cover which protects it from dirt and foreign substances when not in use.

This method is typical of all of the manufacturing operations where it can be applied. As explained in the article describing the new building, every angle of present and probable future manufacturing requirements was carefully studied out, and equipment was grouped both horizontally on each floor and vertically on successive floors so that the progress of materials from operation to operation would be as direct and simple as possible. Expansion of the business was provided for by leaving space for the installation of additional units, where sales forecasts showed the probability of their need. Hence, in casting the concrete floors, openings were left at points where immediately or later they would be required to feed machines, and the space on floors below was assigned to present or future equipment for the particular process in question.

Emphasis is again placed upon the fact that the new building was not laid out merely with the idea of performing chemical and mechanical processes successfully and economically, and without any great attention to the intermediate handlings required. Neither was an elaborate and expensive handling system developed, into which the manufacturing processes were made to fit. In the course of the study, layouts were devised which were probably characterized by both these independent lines of thought. But the separation of the two functions, processing and handling, thus worked up individually, was finally coordinated into the correct composite, and the finished building, operating now for the past nine months, has amply justified the time and care spent in planning it.

Naturally, due to the present lack of adequate standardized methods of engineering and accounting study, only rough estimates can be placed upon the savings brought about, and perhaps many economies will be forever hidden among the figures making up the annual balance sheet. Just how much saving to credit to improvements in processes and equipment, and how much to attribute to better methods of material handling, are questions which cannot be accurately nor perhaps even approximately answered. But the very directness of manufacturing and handling, coupled with proper maintenance of equipment and expert operation by skilled workmen, means continuous quality production with a minimum of executive supervision, in addition to the elimination of waste labor.

Further details of handling during manufacture would be of special interest only to men engaged in the same or a very similar line of work. Moreover, they would differ only in the kind of product turned out, and the consequent variation required in the han-

FIG. 3 MATERIALS ARE STORED NEAR FLOOR HOPPERS THROUGH WHICH THEY ARE FED TO MACHINES

dling at each step. Essentially, every material goes to one of the upper floors above the fifth (even the many water tanks are at the top of the building) and flows by gravity from process to process down through successive floors, until it is ready to go into the individual containers and be finally packed for shipment.

The fifth floor forms the starting point of filling

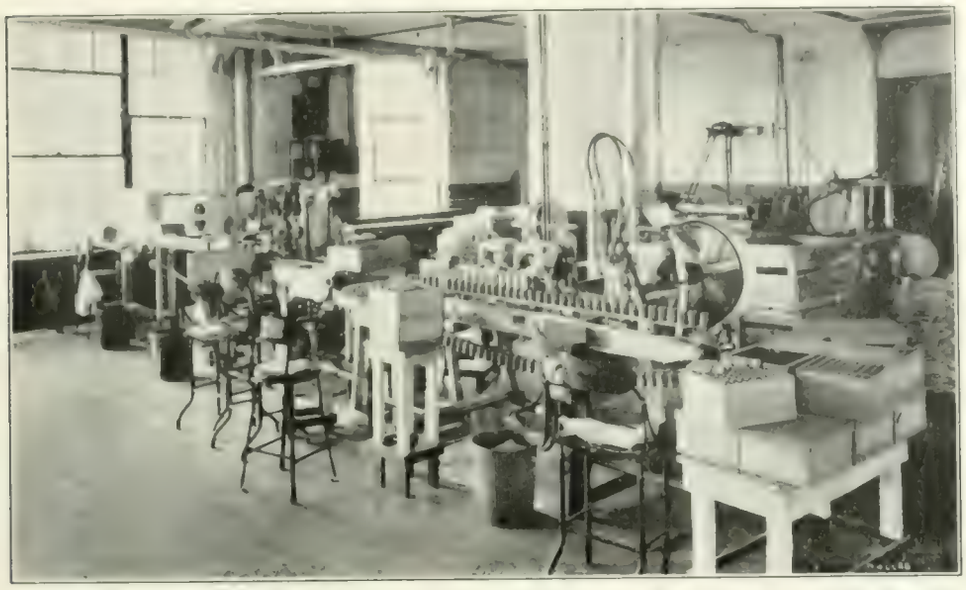


FIG. 4 ONE OF THE DENTAL CREAM FILLING UNITS

operations. One typical process, that of filling tubes with dental cream, is illustrated in Fig. 4, which shows one battery of several used in this work. The empty tubes, already capped but wide open at the bottom, are received in cardboard boxes, carried in wood crates from the maker, come into the receiving department, like other materials, and are brought by lift trucks on elevators to the fifth floor, into storage space beyond the new building (on one of the floors of the adjoining old building). They are unloaded at the filling tables as needed.

Dental cream is delivered from its final manufacturing process through tubes into filling machines. These pump measured quantities through tubes of a diameter to suit the metal containers, which move on the machine in a row of holders carried by an endless chain. Filling, closing, wiping, folding and clipping are all performed automatically by successive operations at the several stations on the machine.

The tubes are deposited on a revolving table where they are inspected and then placed on a conveyor feeding the next machine. This machine wraps a circular around each tube, deposits it in a folding carton and seals the ends. These cartons, after inspection, are packed by hand, in larger containers holding 12 each, at the far left in Fig. 4, and are then placed on a belt conveyor traveling up the department, where they are packed in larger shipping containers. Spiral chutes carry them to the order filling department storeroom on the first floor.

The filling and handling operations for milk of magnesia, another Squibb product, are illustrated in Fig. 5. Bottles are received in inverted position in corrugated shipping containers holding 12 each. These are carried to the sixth floor where they are stored until used. A spiral chute, shown in Fig. 5 delivers them to the floor below, and a roller conveyor carries them to a revolving table where the cases are emptied. The cases are reserved as containers for filled and finished bottles.

The bottles are inverted over pegs on a washing table and are thoroughly washed by hot water. Then they are run through the adjacent machine which fills them. From there they pass through a capping machine and then through a labeler and over a conveyor table where they are individually wrapped. At the end of this conveyor table they again arrive at the starting point, and are placed in their original shipping containers. The conveyor table adjoins the right-hand end of the roller conveyor in Fig. 5.

Filled cases are glued and closed, and run through the power-driven sealer. They are then automatically counted, and discharged into a second spiral chute which carries them down to the storeroom. A view of the delivery end of one of these Otis Elevator Company 4-system spiral chutes is shown in Fig. 6. Cases shoot out on the receiving table and are piled on a lift truck platform nearby. The product shown in the illustration happens to be epsom salt, which has followed a course similar to other products in its preparation, packing, and final delivery to the storeroom.

The lift platforms are moved to convenient points until shipments are made, when they are unloaded. If large quantities are sent out at once, whole platform loads are moved bodily over to the shipping conveyor. This conveyor is the one mentioned at the beginning of the article (see Fig. 1) and passes under the street.

FIG. 5 FILLING AND PACKING MILK OF MAGNESIA

FIG. 6 SPIRAL CHUTES END AT STOREROOM ON FIRST FLOOR

It is reversible, and when run backward carries goods to the shipping department instead of in from the receiving department.

The second conveyor under the street is non-reversible and serves for shipping only. It is the outlet line for the Dow conveyor system shown in Fig. 7. The products on that gravity roller conveyor are placed there from storage, or from special packing departments to be described later, are checked and stencilled by the order filling department, and pass down a short chute to the apron conveyor under the street.

Not all products go out in bulk. Many shipments are made up of smaller quantities of an assortment of pharmaceutical products, in dozen lots, or so. Storerooms are maintained on the third and fourth floors of the older connecting buildings, and here small packages of products are kept classified on shelves.

Orders for miscellaneous products are sent to this department and the packages called for are placed in boxes separate for each order. These boxes travel on a belt conveyor to the packing rooms immediately adjacent to the main storeroom. In the first room the boxes containing export shipments are taken off and packed to conform to the requirements of steamship companies and the importing countries. This work is done by men familiar with such requirements. In the second room parcel post shipments are made into packages that are safe and conform to postal regulations. In the third and fourth rooms express and freight shipments for country and city delivery, respectively, are carefully packed to prevent loss or breakage in transit.

The shipping containers thus filled are moved by trucks to the spiral conveyor which delivers them to the gravity roller conveyor shown in Fig. 7, and from thence, after weighing, adding case goods, marking and checking, to the shipping room. Empty temporary boxes used by the miscellaneous package storeroom to collect orders are placed on a return belt, which runs beneath the conveyor taking orders down from these points, and are sent back to the storerooms.

From the above outline it is clear that no unnecessary travel of materials in process or finished products is permitted. The layout adopted automatically routes everything, whether in raw or completed state, directly on its way by the simplest possible means. Traffic congestion is thereby avoided, and definite courses for each material or product to follow eliminate delays in processing, packing and shipping and cut executive supervision to a minimum. Order, speed, sanitary conditions, and correct administration and execution of work are brought about of necessity by the plan adopted.

This comprehensive plan was not by any means an accident nor a hastily devised method. It was based upon years of special experience in the business, and intimate knowledge of all its present and possible future requirements, and then a careful, tried and many times retried, arrangement and grouping of processing and handling operations was made, until finally the full result was achieved and put into effect.

A trip through the plant shows all floor area usefully occupied, so that maximum return on the building investment is assured. When sales demands increase and additional equipment is placed, slight readjustments in present stocks carried and methods followed are bound to occur. But the capacity of the handling equipment is ample to enable it to keep pace

FIG. 7 GRAVITY ROLLER CONVEYOR CARRYING ORDERS READY TO SHIP

with the manufacturing equipment, and expansion of business will mean, in the main, simply a larger and quicker incoming and outgoing of materials and products. No trouble is anticipated because the facilities have been studied out purposely to avoid any "neck of the bottle" as manufacturing expands. New lines of products, as taken on, will naturally be made in the contemplated new building so that the scheme laid out for the present structure will serve its purpose effectively for many years to come.

# An Effective Production Control System

## Employed in the Manufacture of Automatic Printing Presses

By JOHN J. SWAN

*Mechanical Engineer*

THE master control board at the Kelly Press Plant[1] carries production schedule sheets for all classes of material, and, in addition, an annual assembly schedule sheet. Referring to this schedule, Fig. 4, under the monthly headings, the figures on the top line, "Week Ending," are calendar dates that close each period, and the letter T indicates "Total for the

| ASSEMBLING SCHEDULE OF KELLY PRESSES | | Kelly Press Division - A.T.F. Co. June 1-1925 to June 1-1926 | | | | |
|---|---|---|---|---|---|---|
| ITEM | MONTH | JUNE | JULY | MAY | JUNE | YEARLY TOTAL |
| WEEK ENDING | | 6 13 ... 29 T | 4 11 ... 27 T | 29 3 10 17 T | 24 1 8 15 T | 1925-6 |
| "S" PRESS | Requirements<br>Shipped | | | | | |
| "J" PRESS | Requirements<br>Shipped | | | | | |
| "K" PRESS | Requirements<br>Shipped | | | | | |
| WEEKLY TOTAL | Requirements<br>Shipped | | | | | |
| MONTHLY TOTAL | Requirements<br>Shipped | | | | | |
| The above provides for the shipment of ... presses from June 1 1925 to June 1 1926 and the assembly of ... presses per month thereafter for ... presses per year. | | | | | | |

FIG. 4. ANNUAL ASSEMBLY SCHEDULE AND PRODUCTION RECORD

Week." This sheet is "marked up" each day in lead pencil, and totals are inked in the last day of each period.

The control board operator, therefore, has before him at all times a complete picture of what exists, is going on, or is planned ahead, and the actual stock of raw and finished parts or material in hand or ordered, as of the day before, and where they are. The master control board is available equally for the manager, purchasing agent, head storekeeper, order clerk, and accounting and cost clerk.

In addition, each manufacturing department foreman has a duplicate set of such sheets as refer to parts for which he is responsible, either to manufacture or to use in his work. These duplicate sheets are likewise kept up to date by the master control board operator or clerk, who goes about extending the lines on the shop department individual books. The red line only is used on the shop sheets, as the foremen are not responsible for raw material in stock.

From the foregoing it will be seen that there are a number of individuals constantly cross checking, so that any oversights or errors are caught at once and nothing can be overlooked.

The key to marking these Class A, B, C, and D sheets is as follows:

The *blue block* (stippled on Fig. 2 of previous article) represents purchase orders for material, Classes A, B, and C. These include commercial parts ordered from jobbers, parts made to the company's drawings, ordered from specialists, and raw material—steel, castings, forgings, etc. The locating of the blocks is assurance that purchase orders have been placed covering the assembly requirements as indicated by its position on the production schedule chart.

The *half blue block* (stippled) signifies that an order for raw material has been placed covering assembly requirements as indicated on the chart, material to be delivered to the plant.

The *red block* (shaded black) indicates that orders have been placed in the company's manufacturing departments covering assembly requirements to the date indicated by the location of block on chart. This applies to Classes B and D.

The *half red block* (shaded black) signifies that a manufacturing order has been placed in the company's factory covering assembly requirements as indicated by its position on the chart.

The *blue line* (stippled) indicates delivery promises or shipments en route. The extension of the line to the right indicates assembly requirements to the period indicated by the chart. This

STORES REQUISITION AND PRODUCTION ORDER

KELLY PRESS DIVISION AMERICAN TYPE FOUNDERS CO
ELIZABETH, N. J.

CLASS
DEL TO DEPT
SCHEDULE REQUIREMENTS TO
W.M.
QUAN
P. LOT

| KIND OF MATERIAL | SPECIFICATIONS | WIDTH AND THICKNESS OR DIAMETER | LENGTH PIECE W.M. PART | QUANTITY REQ | DEL | DUE | C | AMOUNT |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

CHARGE LABOR AND MATERIAL TO W. M.

FIG. 5. STORES REQUISITION AND PRODUCTION ORDER (FRONT)

[1] See December 1925 issue, pg. 817-20 for the first part of this article.

applies to schedule sheets for Classes A, B and D.

The *red line* (shaded black) indicates actual deliveries of completely finished parts in the company's store room. The extension of the line to the right indicates assembly requirements to the period indicated by the chart. This applies to Class A, B and D.

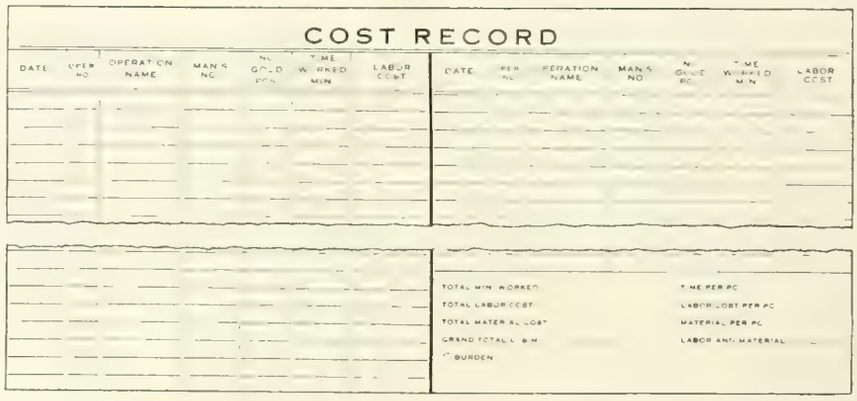



FIG. 7 STORES REQUISITION AND PRODUCTION ORDER (BACK)

When the master control board shows that it is time to order a new supply of any part manufactured in the shop, the planning and scheduling section fills out in quintuplicate a Stores Requisition and Production Order, Fig. 5. This states the class of material wanted—A, B, C, or D—works material number, total quantity, in what sized lots to deliver, and where to deliver. It tells the kind of material, with specifications and dimensions, and provides for recording part deliveries and value. Spaces are also provided for countersigning by all parties responsible for requisitioning, delivering and receiving.

The five copies are distributed as shown by the chart, Fig. 6. The white original is retained for record in the files of the planning and scheduling section. The back of this form is ruled and headed as shown by Fig. 7 to permit all essential labor cost items to be entered. The second copy, also white and ruled on the back as shown by Fig. 7, goes to the cost department, and is held there until the order is completed and all labor cost items entered on the back, when it

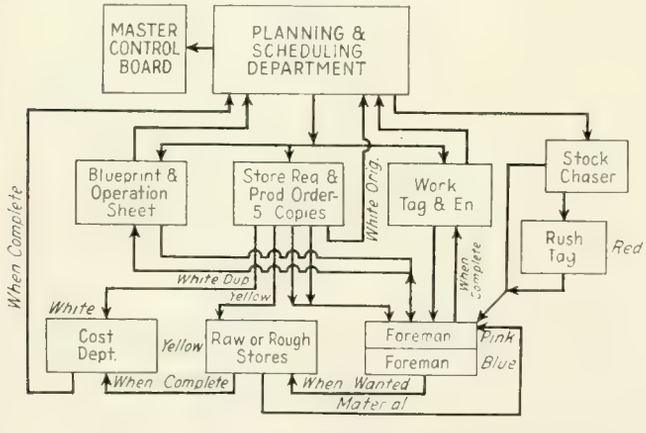



FIG. 6 ROUTING OF MANUFACTURING ORDER

is returned to the planning and scheduling section.

A yellow copy goes to the rough or raw stores department, and is held there until all material required on the order has been delivered to the proper foreman, when this yellow copy is sent to the cost department. Two copies, one pink and one blue, are given to the foreman of the department that will manufacture the part or parts. At the same time, the planning and scheduling section furnishes the foreman with all necessary blueprints and operating sheets, and an envelope containing a work tag, Figs. 8 and 9.

When the foreman is ready to begin work, he sends his blue duplicate order to the rough stores keeper, who delivers the material called for as specified by the manufacturing department foreman. When the order is completed the foreman returns the work tag, envelope and any other contents, and the blue prints and operation sheets to the planning and scheduling section, which is thus advised of the completion of the order. The information is then entered on the master control board as completed, i. e., the red line is correspondingly extended on sheet D.

The superintendent under the production manager (works manager) also has stock chasers who watch the control board and follow up the foreman. See Fig. 14. If the work is lagging or needs to be advanced, the chaser attaches a red rush tag, Fig. 10, to the work tag, and advises the foreman.

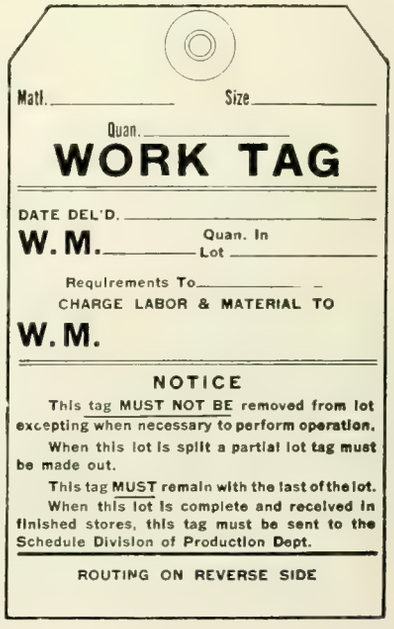

Matl.
Size
Quan.
WORK TAG
DATE DEL'D.
W.M.
Quan. In Lot
Requirements To
CHARGE LABOR & MATERIAL TO
W.M.
NOTICE
This tag MUST NOT BE removed from lot excepting when necessary to perform operation.
When this lot is split a partial lot tag must be made out.
This tag MUST remain with the last of the lot.
When this lot is complete and received in finished stores, this tag must be sent to the Schedule Division of Production Dept.
ROUTING ON REVERSE SIDE

FIG. 8 WORK TAG (FRONT)

If the material required, as shown by the master control board, is to be purchased on the outside, the routine differs slightly. In this case the planning and scheduling section originates a requisition, Fig. 11, with duplicate for its file.

This requisition is also in general use for office and various supplies other than distinctly productive material. It gives quantities and full identifying information, and must be approved by the production manager. The original (green) is delivered to the purchasing department, which gets quotations, if desired, and makes out a purchase order in quintuplicate, the several copies being routed as shown by Fig. 13, which also shows the production department's position as the originator of the order.

The original, when approved, goes to the vendor, the

duplicate to the purchasing department file for record. Two white copies go to the receiving department, one for its record file, the other to be returned to the purchasing department when the material is received. The remaining copy, pink, is held by the purchasing department until the order is actually placed with the selected vendor, when it is sent to the planning and scheduling section. Then the planning and scheduling section enters the fact on the proper sheet of the master control board.

From the foregoing it will be seen that there are checks, counter checks and clearances between all involved departments, but the general control resides in the planning and scheduling section of the production department, actually under one head.

The details above described will enable one to understand the operation of the master control board and the use of Class A, B, C and D sheets, shown in Fig. 2 of the previous article. Note that this particular sheet begins with January 1, 1925. Also that the lines shown are arbitrary, and purposely do not show actual figures. The broad shaded lines are supposed to be red, and the broad stippled lines blue. Red lines (shaded black) indicate actual deliveries of completed stock in stores. Blue lines (stippled) indicate deliveries promised, or en route.

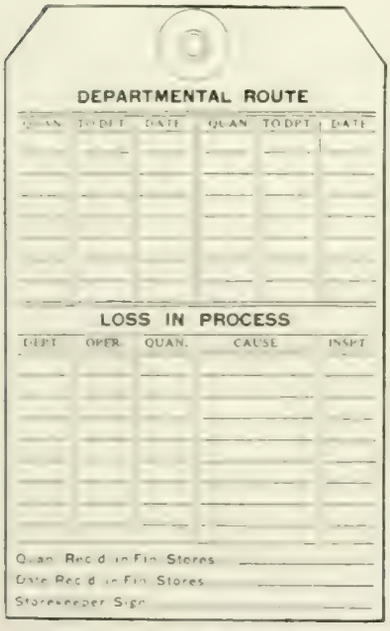



FIG. 9 WORK TAG (BACK)

Classes A, B, and C sheets cover purchased material; Class D sheets cover manufactured or purchased material actually in stock.

We will also assume that we are striking a balance for the end of the first period of April. Referring, then, to the first line, W. M. No. 13700, reversing crank, we see that only one of these parts is used for each K-type press. In column ten, 10 K presses are required for delivery per period, or a total of $10 \times 1 = 10$ parts are needed per period. The broad light shaded lines show that at the end of the first period of April the plant was ahead of schedule. The shaded square in the fourth period of April shows that a production order is actually in the department making this part, to cover requirements to the end of the fourth quarter of April, three weeks ahead. Column nine will show that 20 days are required to manufacture a new stock. Column eight will show that 160 parts is the number to order for a grand period of four months. We note also that although the stock on the first order is almost used up, there is another

FIG. 10 RUSH ORDER TAG

shaded block in the fourth period of August, i. e., for completion at that time. Hence this item is properly cared for, so far as manufacture is concerned.

Now look at the stippled line, i. e., material from which the part is made. This extends clear through to the fourth period of August, showing ample material, possibly too much, but the black half square in the fourth period of December shows that a still further order for material has been placed. Evidently the vendor requires considerable time to get out such an order, or the purchasing department has found it possible to get a better price or quality by ordering ahead.

Running down the sheet (Fig. 2) to the tenth line, W. M. No. 13850, impression cylinder, we find that one of these is required for each S-type press. The schedule calls for completion of 24 of these presses per period, or $24 \times 1 = 24$ per period. Under February we find production of these parts has reached only the

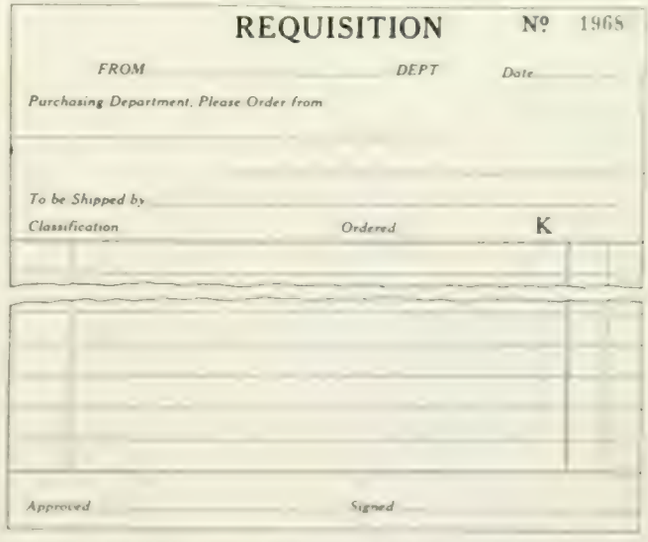
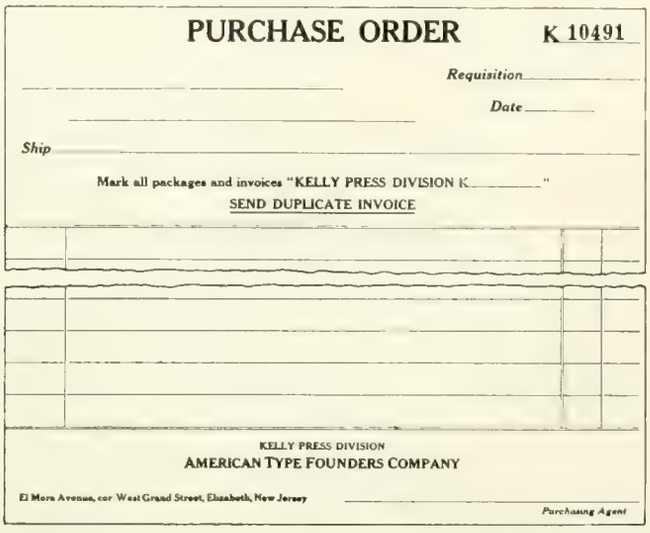



FIG. 11 REQUISITION FORWARDED DIRECTLY TO PURCHASING DEPARTMENT

end of the third period. The particular department responsible for manufacture of this impression cylinder is therefore five periods behind the schedule, as of the end of the first period of April, our balance date.

The light block in the fourth period of April shows that a production order covering all requirements is

in the foreman's hands. The stippled material line shows ample raw material for scheduled production up to and including the first period in June, with a further delivery due to the end of August, and another material order in for requirements to December 31. It is evident at a glance that this part, 18350, impression cylinder, an important part in the S-type press, is holding up delivery of these presses, and that the shipment schedule is two weeks behind on this account.



PURCHASE ORDER K 10491

Requisition

Date

Ship

Mark all packages and invoices "KELLY PRESS DIVISION K"

SEND DUPLICATE INVOICE

KELLY PRESS DIVISION
AMERICAN TYPE FOUNDERS COMPANY

El Mora Avenue, cor West Grand Street, Elizabeth, New Jersey

Purchasing Agent

FIG. 12 PURCHASE ORDER (ORIGINAL) SENT TO VENDOR

What is the reason? This is up to the production department. It may be some change in design, a breakdown of an essential machine or tool, defective castings requiring replacement or repairs, lack of sufficient equipment, need of change in method, or some other reason in the manufacturing department producing this part. At all events, the fact stands out on the control board, and everybody concerned is at work to locate the cause and correct the conditions as soon as possible.

### STOCK SEVERAL MONTHS AHEAD

Referring to the fifth from last item on the sheet, W. M. No. 16001, shoofly finger, it will be seen that four of these are used for each S-type press. The schedule at top of column 10 calls for 24 presses per period (week), or $4 \times 24 = 96$ total per period. The shaded production line shows a stock already produced to cover requirements to December 31, and naturally raw material for that amount, as indicated by the stippled line. This would seem to indicate a badly unbalanced production, but it happens that 16001 is a punched part, and the total requirement for a year's production, under the set schedule, is 96 parts per period $\times$ 12 months $\times$ 4 periods $=$ 4608. Hence it is obvious that it is economical to run out the entire number with one setting of a punch press.

From these two extreme examples the other items can be studied and the system clearly understood.

Actual experience over some time shows that this method of production control meets all conditions in a very practical and successful way. In the case of the Kelly Press plant, the total number of different parts is about 3150, and the annual production over 2100 presses per year. Table 1 shows that the annual output is about 6300 tons of high grade, accurate machinery, involving the manufacture or procurement of about 6,778,000 parts and pieces. But even with this volume, the production master control board and foremen's departmental production charts require only one operating clerk, and part of the time of a stenographer to make out orders and requisitions.

### ORGANIZATION AND PERSONNEL

Fig. 14 illustrates the organization and personnel of the entire production department, with lines of authority and responsibilities or functions. This should be studied in connection with Fig. 15 which shows the production department office layout and relative desk positions of the individuals performing the various functions illustrated in Fig. 14.

The approach from the shop is from the right, hence

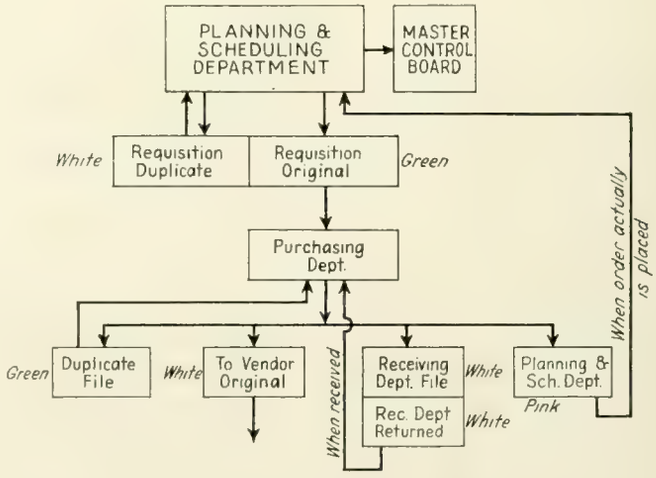



FIG. 13 DIAGRAM SHOWING ROUTING OF REQUISITION ORDER

desks for functions requiring frequent contact with the shop are at the right. Next come those requiring less frequent contact with the shop, and also contact with the works manager and superintendent, who are placed close together and remote from the outer working line. The master control board is readily accessible to fore-

TABLE 1. PRODUCTION CONTROLLED BY ONE CLERK AND ONE STENOGRAPHER (PART TIME)

| TYPE | SCHEDULE NUMBER PER MO | APPROX NO. DIFFERENT PARTS | TOTAL NO. PARTS INCLUDING DUPLICATIONS | TOTAL PARTS PRODUCED PER YEAR | WEIGHTS | | |
|---|---|---|---|---|---|---|---|
| | | | | | APPROX NET WT. EACH, LB. | TOTAL NET TONS PER MO | TOTAL NET TONS PER YEAR |
| J | 40 | 948 | 2,291 | 1,099,680 | 4,000 | 80 | 960 |
| S | 96 | 1,710 | 4,700 | 3,385,000 | 4,900 | 235 | 2,820 |
| K | 40 | 2,844 | 9,580 | 2,293,200 | 10,500 | 210 | 2,520 |
| Totals | 176 | | | 6,777,880 | | 453 | 6,300 |

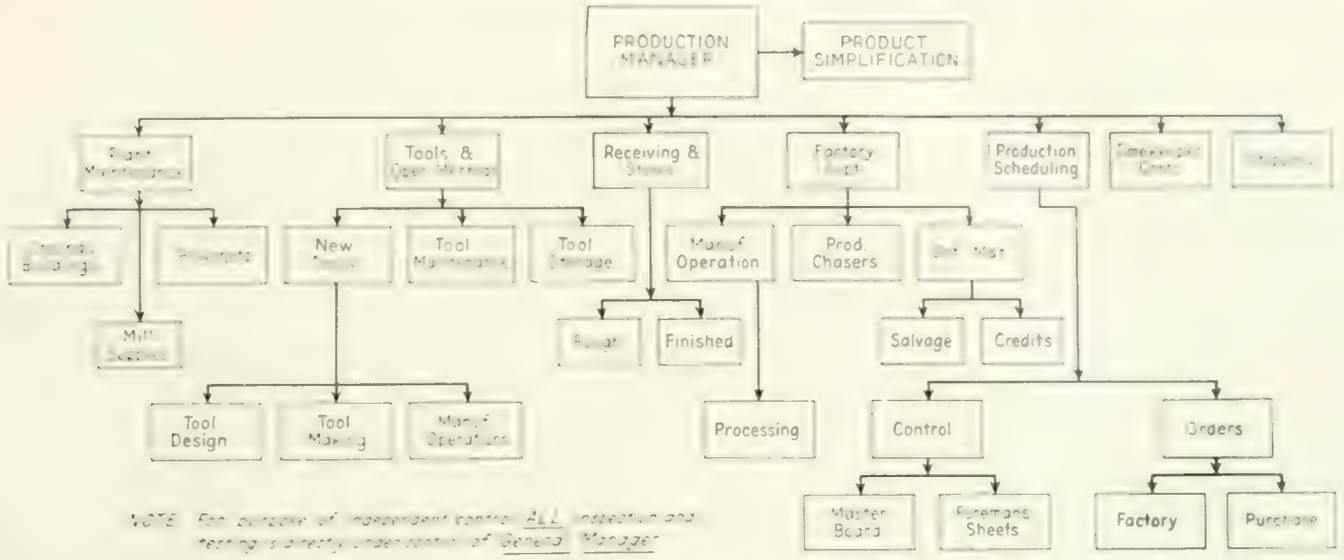



FIG. 14 ORGANIZATION CHART AND FUNCTIONS OF PRODUCTION DEPARTMENT

men and others from the shop, the production manager, superintendent, and to the conference room where foremen's meetings are held.

In conclusion, attention is again called to the fact that these sheets covering material classification and production control have been developed and copyrighted by W. M. Kelly, general manager. We are indebted to him for the data in this article, and also to H. H. Edge, works manager, who has been responsible for working out the details of the plan, and for the accomplishment of the satisfactory results obtained.

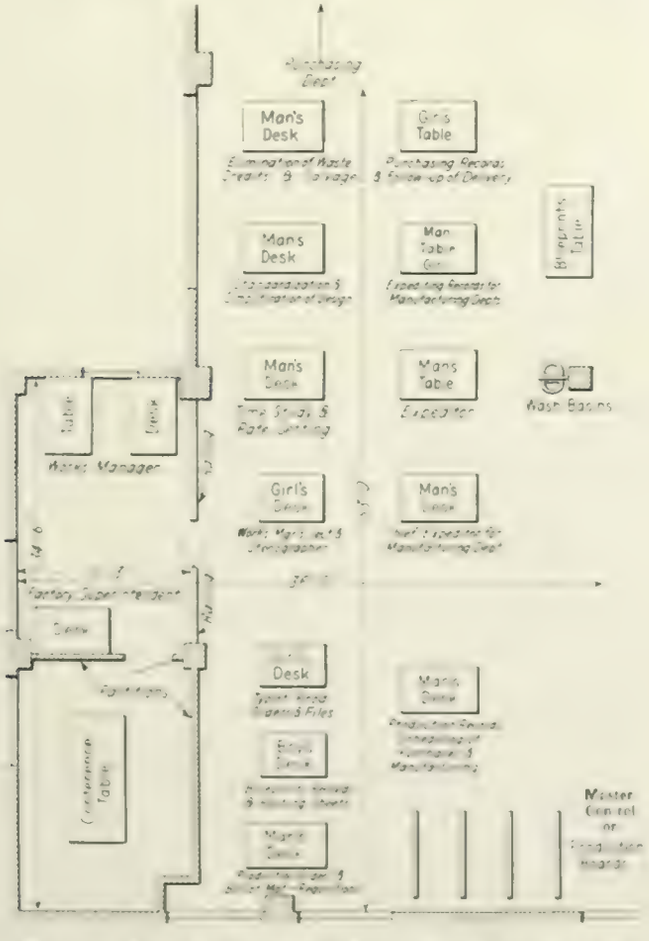



FIG. 15 OFFICE LAYOUT OF PRODUCTION DEPARTMENT

## Simplified Practice Progress

THE Division of Simplified Practice, Department of Commerce, reports in its bulletin that requests have been received to consider the simplification of hard surface floor coverings such as linoleums, congoleums, oilcloths, etc. The members of the Floor Covering Association are being canvassed for suggestions through their secretary.

Makers of steel sash have declared that considerable reductions are possible in size and variety in this commodity and have asked the Division's co-operation in developing a program of simplification.

A committee which is studying the existing variety in sheet metal ware with a view to preparation of simplified practice recommendations reports that it is nearly ready to submit a program to a general conference in January.

Reductions amounting to approximately 75 per cent in the variety and sizes of die head chasers used in automatic screw threading machinery were adopted by a general conference of manufacturers, distributors and consumers on December 4. The manufacturers estimate an annual saving of $500,000 as one result of this step, not to mention great improvements in convenience to users.

At a conference of makers, distributors and users of sidewalk and vault glass, architects and others, held on November 18, reduction of styles from 80 to 5; sizes from 120 to 6; and 10 shapes to 2 was adopted unanimously.

The American Engineering Council is planning a five-year program of research, and has asked the Division of Simplified Practice to have a part in the drafting of this program. This indicates the close liaison between the two bodies.

# A Neglected Phase of Cost Accounting

By J. W. ROBINSON

*Chartered Accountant; Late General Secretary, Thomas A. Edison Industries*

COST accounting deals with the cost of materials, cost of direct labor—that is, labor applied directly to the product—and overhead expense. Getting the cost of material placed where it belongs is, in the main, fairly simple, and so is the charging of what is termed "direct" or "productive" labor to the cost of the product. It is in the problem of properly distributing overhead expense, including "indirect" or "unproductive" labor, that accountants find their difficulties.

This is true not only of manufacturing plants, but also of selling businesses. However, indirect labor usually receives the accountant's attention only in connection with the general problem of distributing overhead expense as a whole.

Close study is made of the cost of direct labor per unit manufactured or sold and its relation to cost and selling price, its variations between periods and between individual workers being used as a yardstick to measure efficiency. The cost of indirect labor is buried in the item of general overhead expense, and, though compared as a total, or perhaps in sub-totals, with its cost in previous periods, and in its relation to volume of production or sales, usually escapes searching analysis.

### Production Departments Know Outputs

The manager of a manufacturing plant, or of a selling force, knows exactly which "productive" departments, and even which individual employees, are helping to produce profits, and which are not. These managers can quickly eliminate the drones, or can take steps to correct conditions which may be the cause of misdirected and unprofitable work. But how seldom is any attempt made to keep account of the value of the work done by "indirect" or "unproductive" employees, and its relation to the wages and salaries paid, and incidental expenses involved.

With certain exceptions, such as typists paid on a lineage or per letter basis, inspectors paid on quantities handled, etc., "unproductive" workers cannot be placed on a piece work or quantity production basis, nor can commissions be paid as in the case of salespeople, but there is no reason for neglecting all attempt to ascertain the value received in return for the wages and salaries paid.

It is the writer's opinion, based on observations made in the course of public accounting, and as an executive of large corporations, that there lies concealed in the items of "indirect" labor, clerical wages, and executive salaries, a vast amount of unsuspected waste.

This waste is probably greater in offices than inside the walls of factories, or on the floors of selling establishments. Factory superintendents, foremen, inspectors, stockmen and timekeepers, and head salesmen, store superintendents, section managers, and department cashiers, are usually very busy people, whose working hours are every bit as productive as those of the "direct" workers. But step out of the factory, or off the selling floor, and you are confronted, in almost every office you enter, with mis-directed effort, haphazard methods, moss-grown routine, and work done at a cost entirely disproportionate to its actual value.

### Cost Accounting for Office Work

Cost accounting has scarcely entered the office, and has not dared to dream of entering the sacred precincts of the executive departments.

In how many offices is known the cost of writing a letter, sending out a bill, entering a regular transaction on the books, or holding a conference? Yet how large these expenses are, and how many units of output must be produced in the plant to pay for each one of these office operations. Some attempts have been made to regulate office costs, but usually they have covered only such insignificant items as supplies—paper, pencils, typewriter ribbons, etc. Labor, the most expensive item, has been utterly disregarded.

It is not hard to get at these costs—much simpler, in fact, than to arrive at the cost of a manufactured unit, or of effecting a sale. Probably the average office worker, from clerk to executive, puts in less than two thousand working hours a year. Salaries are more or less fixed, office expenses are known, and arrival at hourly rates is easy. It is not difficult to count the number of letters sent out, or transactions handled, nor to time the beginning and end of those weekly, or perhaps daily, conferences, committee meetings, and the like.

### What Do Conferences Cost?

If conferences were "costed," there would be less of them, especially if the cost were carefully weighed against the actual results attained.

If the letters personally dictated by high-priced executives, taken down by stenographers (instead of being dictated to an Ediphone), typed, reread and signed, were costed, much wordy and unnecessary correspondence would be cut out, and a great proportion of the routine letters which many executives now insist on personally dictating would be left to subordinates to handle.

If the cost of work done by executives, junior executives, accountants, clerks, stenographers, and "indirect" workers generally, were figured as closely as is that done by "direct" workers, there would be an immediate and drastic reduction in the army of "white collar workers."

# Management in Lumber Dry Kilns

## Useful Methods for Determining Costs of Handling and Drying

By THOMAS D. PERRY

[illegible]

POOR Richard's admonition, "Save the pennies and the dollars will take care of themselves," is as true today as when it was first published. Its observance in woodworking plants appears to vary according to the familiarity of the accounting department with the particular kind of expense involved. Nickels, dimes and quarters spent for postage, fares, telegrams, telephones, stationery and the like, are laboriously enumerated. Recognized and familiar

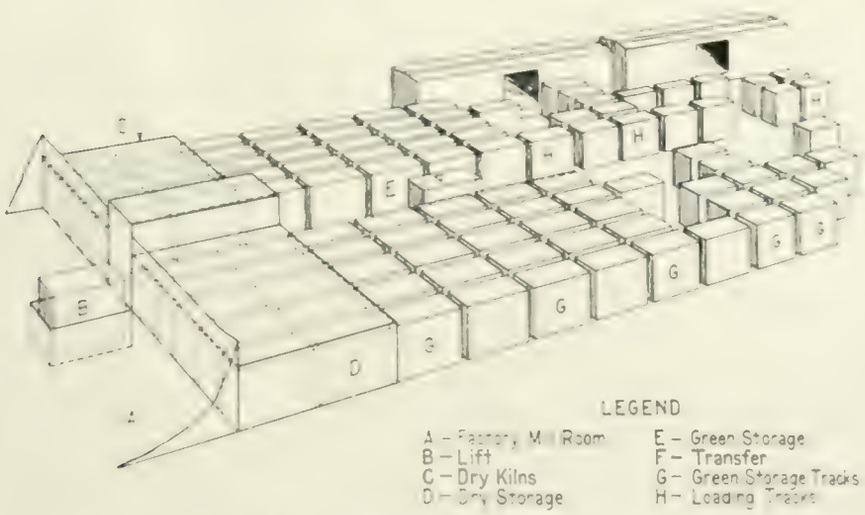



FIG. 1. LAYOUT OF MODERN LUMBER YARD

items are not overlooked. But the entire range of lumber and dry kiln records and costs is a relatively unknown quantity, and rarely enters into the average accounting system, except in the form of monthly, quarterly or annual aggregates.

The use of 1,000,000 ft. of lumber per year, or approximately 3000 bd. ft. (one kiln car) per working day, is a modest consumption, and many thousands of plants use more. Yet even this moderate utilization involves the use of considerable money, viz.:

| | | |
|---|---|---|
| 1,000,000 ft. at average cost per 1000 ft. of from $50 to $100 | $50,000 to $100,000 | |
| Yard and kiln deterioration, 5 per cent on value | 2,500 | 5,000 |
| Unloading and handling through kiln into factory, $4 to $6 per 1000 ft. | 4,000 | 6,000 |
| Kiln drying costs, according to thickness and greenness, $4 to $10 per 1000 ft. | 4,000 | 10,000 |
| Total | $60,500 | $121,000 |

It is probable that unit items above and subsequent costs might be somewhat reduced in larger plants (increasing this ratio of a smaller plant will undoubtedly be safe), but it is certain that the costs extended are conservative, and considerably below averages in many existing plants.

A thorough and accurate account of stock representing such a substantial sum of money should be carefully maintained at all times.

In order to examine the possibility of such records in some detail, it will be advisable to assume a modern lumber yard layout on wheels, with adequate dry kilns, transferring and shifting tracks, green and dry storage, and lumber lift for unloading at saw or planer, all substantially as shown in outline plan, Fig. 1. The size and capacity are estimated to produce one kiln car of dry lumber daily and to keep constantly three months' supply on hand ready for use.

### TWO KINDS OF RECORDS

The problem involves, first, a simple and comprehensive record of the quantities of lumber received and forwarded through the yard and kiln, showing its treatment, condition, and location at any time; and, second, the aggregate annual cost of handling and drying, with suitable overhead, and ample allowances for appropriate deterioration and depreciation, the whole being customarily spread on the lumber cost per thousand feet.

For purposes of convenience, all record blanks should be $8\frac{1}{2}$ x 11 in. sheets, punched for loose leaf binders. Cards can be used, but are more likely to be lost or misplaced.

Every kiln operator not only should have "wood sense" intuitively to recognize the character and under-

stand the treatment of wood, but should also be competent and interested enough to keep adequate and systematic records. Such records are not only necessary for the business, but they also demonstrate the care and accuracy with which the operator performs his duties, and provide a defense in the face of unjust criticism, for the poor kiln operator certainly does receive more than his fair share of criticism.

Lumber received is indicated at first by inbound railroad car number. The subsequent identification is carried forward by kiln car numbers (when lumber is transferred thereto) as soon as such are assigned and kiln cars tagged. A form is suggested in Fig. 2.

It might be possible to crowd two car records on one sheet, but this is liable to result in confusion over kiln car numbers, shown in the upper right-hand corner. No price is extended, as all lumber records in the yard office should be quantitative only, price figures being added by the purchasing department only when wanted. Additional information may be included, but the simpler the form the better, and the greater the probability of its proper and complete use. These forms are often filled out in duplicate or triplicate for superintendent's office, purchasing department and kiln operator's record.

### Numbering and Tagging Kiln Cars

Each railroad car, holding from 15,000 to 20,000 ft., will fill from five to seven kiln cars, on which lumber should always be separated for thickness, and so far as possible segregated for length, to prevent sagging

NOTE

**LUMBER RECEIVED**
BLANK FURNITURE COMPANY
James Rapids

| | | |
|---|---|---|
| R. R. INITIALS | *Lou & Nash* | |
| R. R. NUMBER | *317,635* | KILN CAR Nos |
| FROM | *Tennessee Lumber Co.* | |
| ADDRESS | *Memphis, Tenn.* | |

| | | |
|---|---|---|
| Kind of Wood | *Sap-gum* | |
| Grade | *F. & S.* | Thick 4/4 & 6/4 |
| Quantity Billed | *12,361–4/4* | 5375 6/4 |
| Received on | *May 3rd, 1924* | |
| Inspected or Scaled by | *A. J. Rice* | |
| Resulting Scale | *12,432–4/4* | 5247 6/4 |
| Loaded on Kiln Cars by | *Jones* | |
| Remarks: | *Lumber too wet — Keep on yard two months before putting into kiln* | |
| | *B. E. K.* | |

Fig. 2 Record of Lumber Received

overhangs. It is customary to scale lumber as it comes from the railroad car, in order to verify invoices, and in smaller yards the same man often acts as yard foreman, inspector and scaler, as well as kiln operator. Scale records can be printed on the back of the sheet in Fig. 2, or scale cards (filled out) can be pasted on it, if preferred.

Kiln car numbers are assigned consecutively and a tough durable tag, Fig. 3, is nailed or tacked in a conspicuous location on each kiln car. These may all be printed with the same form, but four or more colors of cardboard are used for convenient separation according to desired treatment.

*Yellow,* or manila, tags are used on lumber that is suitable to go directly into kilns, that has been verified properly as to grade and scale, and that follows the normal procedure. The record on this tag down to "entered kiln" is filled out when first placed on kiln car, and remaining entries are made as car progresses.

Fig. 3 Kiln Car Tag

Made in 4 colors: (1) Yellow—follows regular course of kiln drying; (2) red—do not use except on superintendent's orders; (3) blue—dry enough to cut when received; (4) green—hold in yard for air drying to 25 per cent moisture content.

*Red* indicates a shipment of lumber received, below grade, checked short on scale, miscut, mixed as to age, or otherwise subject to rejection or price adjustment before going to kiln. When released, either the red tag will be torn off and destroyed, copying the data on the replacing tag, or the red tag will be covered with another color.

*Blue* tags indicate lumber sufficiently dry to use without going through the kiln, such as custom dried in transit, crating stock that does not require kiln drying, etc. For convenience in shifting around the lumber yard such stock is best piled on kiln cars, with or without stickers.

*Green* tags are true to color, and indicate lumber too green to go into the kiln, and that must remain "stuck" on kiln cars in the yard until the moisture content drops to 25 per cent, or other designated limit.

Other colors can be used singly, or in combination, to cover local conditions, to indicate various shippers, or to identify different woods and cuts. Simplicity, however, makes for accuracy.

### Final Disposal of Tags

These tags remain on the kiln cars until they reach the first saw or planer, and are then removed and turned in with time cards as evidence of the amount of lumber cut.

This color scheme is substantially the one used by W. S. Milne, of Chattanooga, where it has served efficiently for several years.

A dummy of a lumber yard is shown in Fig. 4, consisting of a small model with movable "cars," which are shiftable wooden blocks (approximately 3 x 5 x $\frac{1}{2}$ in.) representing one kiln car each. There is enough of the "game" instinct in all of us to want to "move" these blocks around into proper position every day,

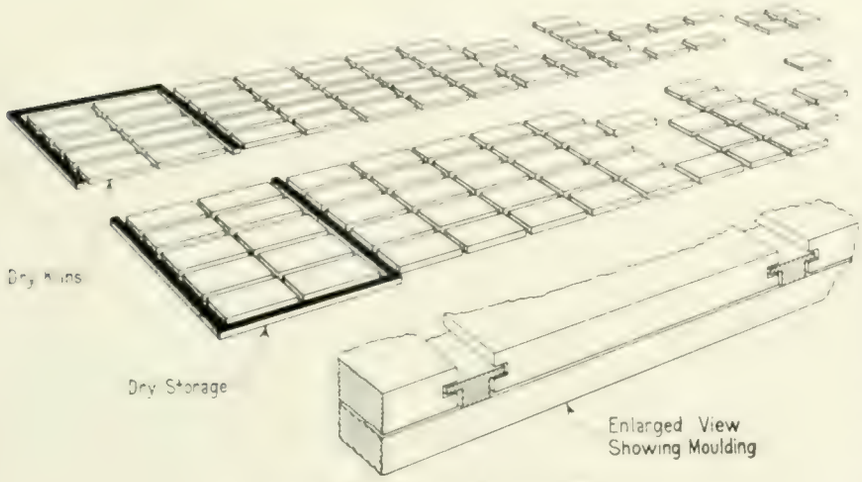



FIG. 4 DUMMY OF LUMBER YARD

like father's interest in playing with son's mechanical Christmas toys. These blocks may be slotted at the ends to slide between mouldings. Celluloid faced blocks, from which records can be repeatedly erased, are best, although in most instances cards are tacked on the blocks and renewed as often as lumber passes into the factory to be cut. Cards may be colored to correspond to tags as described above.

Such a graphic representation of the lumber yard is remotely descended from the illuminated dummy of the railroad terminal yard in the dispatcher's office. Its value is obvious for the purpose of quickly locating a kiln car of the desired lumber, or planning what cutting orders will be next supplied with dry stock, or determining the assortment of stock with which the kiln is to be charged; in other words, it is a flexible visual control board. Such a miniature yard is usually located in the office of the superintendent of woodworking, or of the general superintendent.

### KILN DRYING RECORDS

The habit of keeping kiln records expresses itself in strange and devious ways, from an old-fashioned journal-ruled pocket book with pencil entries, to a most carefully drawn graphic chart with multi-colored India ink lines; from a chalk date on the kiln door when lumber enters (to be erased when discharged), to a carefully compiled record on a clip board hung on each kiln door. Most of the methods are inadequate.

The real effectiveness of a kiln record is scarcely appreciated by the rank and file of woodworkers, many of whom regard it as a theoretical and technical "collegiate" stunt, and unworthy of and unnecessary to a "practical" artisan. The writer, during some ten or more recent years, had access to the records of one of the larger kiln construction companies, and experience with some 4000 kilns proved conclusively that the kiln operator, without much in the way of records, is in trouble about 20 times as often as the operator with well maintained records. Approximately 95 per cent of the complaints received were from kilns operated by "judgment" (guesswork and luck), or from kilns where it was assumed (quite optimistically) that kilns would govern themselves, or from kilns where occasional superficial tests were made with instruments, such tests being spasmodically recorded. The other 5 per cent had legitimate grievances—faulty control devices or instruments, unfamiliar species of lumber, stock damaged before receipt and the like. In other words, adequate records of what happens in the kiln from day to day were most clearly proven to be worth while as an insurance against lumber drying troubles.

Not only is the moral influence of a required adequate record effective in avoiding carelessness on the part of the operator, but it serves as a basis of careful diagnosis as to why a certain charge of lumber was well dried (showing valve and damper settings to secure desired conditions), or reveals the reasons why the particular drying operation resulted in costly

**TABULAR BOX KILN DRYING RECORD**
of
**Blank Furniture Co.**
James Rapids

Kiln No _____ Kiln Car Nos
Date Entered _____ Removed _____
Wood _____ Thick _____ Condition _____

| Dates | Time of Reading | Position Spray Valves | | Position Steam Admission Valves to Coils | | | | | Position Air Dampers | | Temperatures Fahrenheit | | Relative Humidity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. 1 | No. 2 | No. 1 | No. 2 | No. 3 | No. 4 | No. 5 | Inlets | Outlets | Dry Bulb | Wet Bulb | |
| 1 | A.M. | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | |
| 2 | A.M. | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | |
| 3 | A.M. | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | |
| 16 | A.M. | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | |

Indicate valve position by $\frac{1}{8}, \frac{1}{4}, \frac{1}{2}, 1, 2, 3, 4, 5, 6$, turns, etc.
Indicate damper position by S, $\frac{1}{8}, \frac{1}{4}, \frac{3}{8}, \frac{1}{2}, \frac{5}{8}, \frac{3}{4}, \frac{7}{8}$, F open, etc.

Moisture Content Tests

| Date | Car No | Wood | M C | Shrink | Date | Car No | Wood | M C | Shrink | Date | Car No | Wood | M C | Shrink |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

FIG. 5 TABULAR BOX KILN DRYING RECORD

damage to much valuable lumber, or may show that under dried stock was heedlessly put in work. This is the reason for the complete recording of the valve and damper positions twice daily.

The form shown in Fig. 5 is a reasonably comprehensive form for single charge kilns, simple enough to be easily managed. The two daily readings, early morning and late afternoon, are quite essential. Valves and damper handles can be equipped with dials or gages for easy reading.

A word of caution should be given against the so-called "automatic" controls for lumber dry kilns. There are three variables—heat, humidity, and circulation; there is as yet no complete controller, manipulating the three into balanced or co-ordinated conditions. Automatic control of one or two variables may be seriously upset by the fluctuations of the uncontrolled element. Still further, present control devices either are too delicate for rough service in lumber kilns, or kiln operators must learn by experience the proper and careful manipulation of such recording and indicating instruments. A careful operator, with "wood sense," and a well-maintained record still continue to be the best guarantee of effective lumber seasoning.

The lower portion of the blank, Fig. 5, provides for tests of lumber for moisture content. Good practice demands that the term "humidity" refer to atmospheric conditions in the kiln air, and that the term "moisture content" apply to the percentage of wetness of the lumber.

The record of a progressive (or continuous) kiln is quite different from a box kiln, as observations must be made simultaneously at entering end, near center, and at unloading end. Fig. 6 covers the essential data, although some operators prefer to amplify the record of lumber tests in the last two columns.

**PROGRESSIVE KILN DRYING RECORD**

Spray pressure live_____lbs. Exhaust_____lbs.
Coil pressure live_____lbs. Exhaust_____lbs.
Total number of cars in kiln when full_____
Each car carries_____ft. of_____lumber_____

Address Black Furniture Co
James Rapids

| Date | Time of Reading | Hour Entered | Car Nos. on Tracks | Thickness | Kind | Green or Air-dried Months | Steaming Room: Spray | Steaming Room: Coil | Steaming Room: Damp Air Pressure | Steaming Room: Fresh Air | Steaming Room: Degrees Wet Bulb | Steaming Room: Degrees Dry Bulb | Steaming Room: Per Cent Humidity | Date and Hour Sent Forward | Middle of Kiln: Spray | Middle of Kiln: Damp Air Pressure | Middle of Kiln: Fresh Air | Middle of Kiln: Degrees Wet Bulb | Middle of Kiln: Degrees Dry Bulb | Middle of Kiln: Per Cent Humidity | Unloading End: Damp Air Pressure | Unloading End: Fresh Air | Unloading End: Degrees Wet Bulb | Unloading End: Degrees Dry Bulb | Unloading End: Per Cent Humidity | Date and Hour Finished | Test: Shrinkage | Test: Evaporation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A.M. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A.M. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A.M. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A.M. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | P.M. | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Signed..... Operator

KEY
S-$\frac{1}{2}$-1-2-3-4-F - Represents number of turns spray or coil valves are open.
S-$\frac{1}{4}$-$\frac{1}{2}$-$\frac{3}{4}$-F - Represents amount fresh or damp air dampers are open.

FIG. 6 PROGRESSIVE KILN DRYING RECORD

## GRAPHIC RECORDS

The above tabular records will always be the most complete, but the "graph" offers a convenient and obvious method to verify records of a box, or single charge, kiln and arrange the main items in visible form so that differences and irregularities can be more easily understood and remedied. Fig. 7 suggests a useful blank for graphic records, with the same opportunity for moisture content data that is given at bottom of the tabular record in Fig. 5.

Frequently the graphic chart is kept in the superintendent's office, filled in every day by the kiln operator from his own tabular record of lumber drying.

The progressive kiln record is not easily reduced to graphic form.

Reference is made in the note at the bottom of Fig. 7 to standard schedules, which should be supplied by each kiln maker. One leaf from such a series is shown in Fig. 8, giving suitable temperatures and humidities for different thicknesses and moisture contents of the lumber to be dried.

## HANDLING AND KILN DRYING COSTS

It has been customary in many woodworking plants to add the yard handling and kiln drying costs (from inbound railway car to first machine operation) to the purchase price of lumber. This may interfere with the "technique" of some cost systems, but has much in its favor as a general policy. It offers a simple basis for determining yield value of the net product, and of comparing the net costs of various grades of lumber, the relative cost of buying lumber already kiln dried, the ratios of value between cutting boards to size or purchasing dimension stock, etc.

The practice of estimating the total drying cost per thousand feet is apt to be misleading since thicker and greener lumber takes longer to dry than thin stock, and also because some woods take longer in the kiln due to fragileness or density. Therefore, the costs derived will be reduced to a service unit of cost per kiln day per thousand feet (KDMF). The simple multiplication by quantity and time of drying will give total cost within a reasonable range of accuracy.

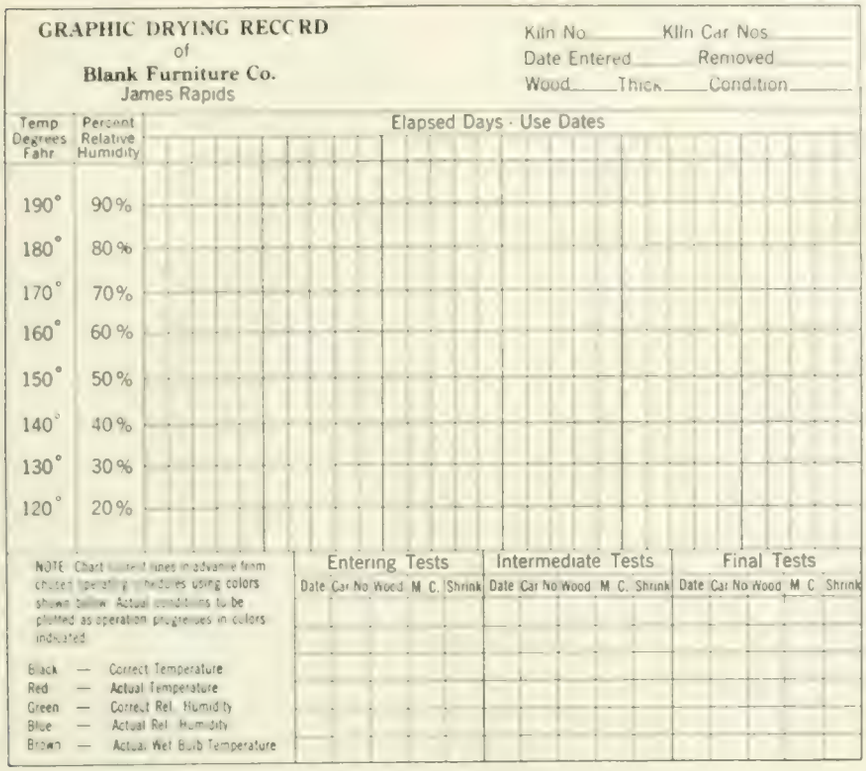



FIG. 7 GRAPHIC DRYING RECORD

Section under elapsed days is ruled in 8 x 8 or 10 x 10 cross sections per inch for easy charting.

The assumption (early in this article) of a daily cut of 3333 ft. (1,000,000 ft. annually) may be considered to consist, as a fair average, of 4/4 in. maple to be dried from 25 per cent moisture content to 5 per cent, requiring eight days in the kiln, and one for loading and unloading, nine days in all.

Since our daily consumption is practically one kiln car, the kilns must have a capacity of at least nine kiln cars; and a duplicate or twin battery of two 5-car kilns is much better than one larger unit. The lay-out shown in Fig. 1 (as well as the dummy in Fig. 4) shows a kiln battery of this size, dry storage of equivalent capacity and yard storage for 100 kiln cars. The initial cost of buildings, equipment, and yard trackage may be assumed as $12,500.[1] If we set aside the following annual percentages for:

| | | |
|---|---|---|
| Interest on investment | 6 | per cent |
| Depreciation of buildings and equipment | 7½ | " " |
| Maintenance and repairs | 4 | " " |
| Insurance, fire | ½ | " " |
| Taxes, local property | 2 | " " |
| Total | 20 | " " |

we will have a total annual charge of 20 per cent. On a $12,500 investment this amounts to $2,500 for overhead.

[1] See *Hardwood Record*, July 25, 1918, the above figures being adjusted for increased building costs.

A minimum yard crew is one foreman (who may serve also as scaler and kiln operator) and two helpers. Handling 1,000,000 ft. annually on a yard laid out for economical handling will not keep them busy, and about one-third of their time can be assigned to loading and unloading inbound and outbound merchandise. Such a crew of three would probably cost:

| | |
|---|---|
| Foreman, annually | $2000 |
| 2 helpers, at $1000 each | 2000 |
| Supervision, factory expense and miscellaneous, at 33⅓% | 1333 |
| Total | $5333 |

If two-thirds of this is used for lumber handling and kiln drying, there result annual charge of $3555 for kiln labor

## MATERIAL CHARGES

Steam costs are rather difficult to compute, since much wood waste is used for fuel and climatic conditions vary widely from month to month. The two 5-car kilns under consideration will contain approximately 2500 sq. ft. of radiation (on a 5 to 1 ratio). This will condense from ¼ to ⅛ lb. of steam per sq. ft. per hr. An average of ⅕ lb. should be adequate as a basis, including steam used for spray. Two tests, each of some 30 days duration,

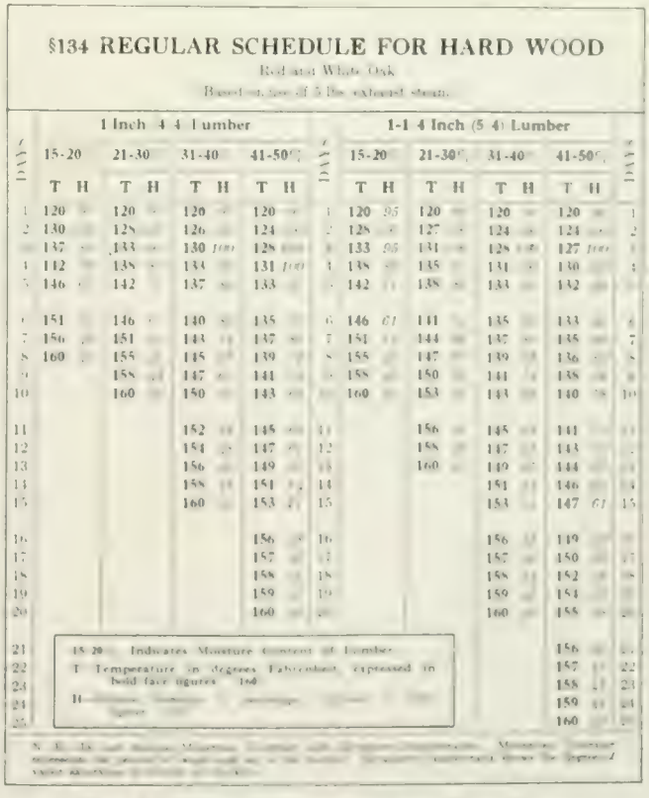



FIG. 8 STANDARD SCHEDULE FOR HARD WOOD

made in Grand Rapids in 1924[2] at the plants of the John Widdicomb Company and the American Seating Company, showed actual condensation of 0.096 lb. and 0.133 lb., without any allowance for steam spray. Averaging and adding 25 per cent for average spray use brings 0.143 lb., or a trifle under ⅛ lb. condensation per hr. per sq. ft. of radiation in kilns: ⅕ lb. will be the safest figure to use.

2500 (sq. ft.) × ⅕ (lb. per sq. ft. per hr.) × 24 (hr.) = 12,000 lb. daily
12,000 (lb.) × 360 (days) = 4,320,000 lb. annually

The cost value of 1000 lb. of water evaporated into steam can be fairly stated as about $0.40. This figure varies widely according to plant conditions, in many cases being much higher; but it is certainly conservative.

4320 (1000 lb.) × 0.40 (dollars per 1000 lb.) = $1728

An additional sum of $500 should be added for stickers, oil, trucking and unexpected contingencies that always happen.

### Recapitulation

Summarizing, we have the following annual charges:

| | |
|---|---|
| Overhead on investment | $2500 |
| Labor, direct and indirect | 3555 |
| Material, steam | 1728 |
| Contingencies, unanticipated | 500 |
| Total | $8283 |

On a basis of 1,000,000 ft. kiln dried annually this would show a net factory cost of $8.28 on 4/4 in. maple dried from 25 per cent to 5 per cent moisture content. If this takes nine days, it would come to practically $0.90 per kiln day per 1000 ft. Caution would suggest that an allowance of $1 per KDMF would be a safe figure to use.

This kiln drying cost can be added to each thousand feet of lumber cut, when it is entered on the cost records. The elapsed time in the kiln is shown on the tag (Fig. 3). The kiln will receive credit for full service done, and there will be a reasonable comparison with the purchase of pre-kilned lumber. Such pre-kilned lumber, in any event, would have to be handled over and if purchased at a differential of $5 could go into costs on a parity with the $8.28 drying above.

### Purchase on Moisture Content Basis

The figures above suggest the possibility of specification buying, with penalty for excessive moisture content. The amount of moisture assumed to be removed was 20 per cent (25 per cent reduced to 5 per cent).

$8.28 ÷ 20 = $0.414 (cost per per cent moisture content). If a deduction of $2 were made for each 5 per cent moisture content in excess of specification, either the buyer could afford to carry the lumber during necessary air drying, or the seller would see that suitably dry lumber was delivered. And the adjustment would be equitable.

### Conclusion

Should this brief outline, urging the keeping of records showing quantities and condition of lumber on hand in yards and kilns, and suggesting a method of determining yard handling and kiln drying costs, result in a better understanding of the subject by the reader, and prompt him to adopt definite measures in his own plant, the message will have done some good. The suggestions, while based on sound actual experience, are unusual in some regards, and questions and queries will be gladly considered.

[2] See *Mechanical Engineering*, August 1924, pages 472-6.

## A Fence Made From Scrap

By H. G. EDWARDS

*The Linde Air Products Company*

ONE large plant recently had need of a strong yet not ungainly fence, with an impressive gateway. They had an ingenious man who saw the connection between a nearby junk pile containing a lot of scrap pipe, the oxy-acetylene blowpipe, and the company's need. Sketches were made and work was started.

The first step was to provide pipe of correct diameter in proper lengths. Long sections were cut to required dimensions with the cutting blowpipe. Short pieces were as easily welded together. When a good supply of usable lengths was on hand, assembling began.

The fence was a simple affair. It was made with all joints welded. Heavy wire netting was used for fence covering between posts. The apparent difficulty of attaching this to the posts was easily overcome by use of the cutting blowpipe. U-shaped cuts were made in each post and the tongue formed bent inward over strands of heavy wire. The methods insured strength and durability.

An attractive gateway was especially desirable, so a little more time and thought were spent in its construction. Carefully graduated lengths of pipe were welded to a straight supporting cross-beam of heavier pipe, forming the bottom of each half of the large gate. Two bent pipe lengths, in parallel curves a few inches apart, were used to round off the top of each half gate. These bends were made by heating the pipe with an oxy-acetylene flame. The space between them was occupied by circles formed by cross sections of large diameter pipe cut with the blow-pipe, and welded in place at equal intervals along the top of the gates.

Using the same general methods, smaller sidewalk gates were made. Concrete gate posts 3½ ft. square gave an imposing appearance to the entrance. The entire cost of erection was slight and a valuable property item has arisen, as if by magic, from a scrap pile.

# What Management Has Done for Us

## Mason Tire Applies Time Study and Establishes Satisfactory Wage Rates by Employee Co-operation

By U. L. HARMON

*Factory Comptroller, The Mason Tire and Rubber Company*

IN many of the articles which are being published today the theory of control is well presented, but it is not always evident how the theory can be readily applied to the various kinds of manufacturing industries. The writer wishes to show in this article what has actually been accomplished in the last three years by applying theory to practice in the plant of The Mason Tire and Rubber Company, Kent, Ohio.

This plant was operated as a great many other plants were before their managers thought of looking into the plan of scientific management. In the years preceding the fall of 1922, the management of the Mason organization established piece-work rates by a "hit or miss" method, taking averages of the production of the better skilled workmen for the various units of work for a period of time, mentally deciding what the workman was to be permitted to earn for a day's wages, and setting the piece-work rate on that particular item accordingly.

As everyone who has had the experience of setting rates in this manner knows, this system would and did breed discontent. In the first place, the average of perhaps a few best men was not a fair day's work for the rank and file of individuals to give to the company, nor was a theoretical rate set by the man in charge of a department a fair way to determine an employee's worth. On the other hand, the piece-workers were afraid to produce any quantity of articles in addition to the average. In the years gone by, whenever this did happen, an attempt was soon made at a downward readjustment of rates. Hence, workmen were constantly in fear of having to do more work for the same amount of money, and of seeing those who were not as skilful, and who were unable to keep up the "pace," thrown out of work altogether. This condition existed at the plant until the fall of 1922.

During the war and the year following, when wages and materials were at their peak, this company, as well as many others, was compelled to pay considerably more for the manufacture of product than was justifiable. When the depression came, and readjustments were necessarily attempted, we, like the others, ran into the usual difficulties which always arise at times like this. We were paying, prior to that time, \$0.50 per tire for the assembly work on a 30x3½ in. tire, and the men who were on that operation were averaging about \$0.85 per hr. We were not interested in a reduction of the average hourly earnings of our employees, but we were anxious to get more production per man employed, so that we could assemble these and the other tires at a lower unit cost. We, therefore, made a reduction of 16 per cent in our piece-work rate, bringing the rate to \$0.42 per tire. When doing so, we changed the working conditions in this department somewhat so that the men could handle the work quicker. They were sufficiently satisfied to work under this new rate, as they were able to earn approximately the same hourly rate as before, namely, \$0.85 per hr.

**OBSERVATION SHEET**

Observer's Name ... Machine No ... Date ... 19..

Workman's Name And Qualifications ...

Part and Size ...

Operations ... Average Deviation ...

| | DETAILED OPERATION | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Total Average | Minimum Selected Minimum |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ... | | | | | | | | | | |
| 2 | ... | | | | | | | | | | |
| 3 | Cement | | | | | | | | | | |
| 4 | ... | | | | | | | | | | |
| 5 | Get Additional " | | | | | | | | | | |
| 6 | Apply 2nd Section of " | | | | | | | | | | |
| 23 | ... | | | | | | | | | | |
| 24 | Roll Down | | | | | | | | | | |
| 25 | Stitch " | | | | | | | | | | |
| 26 | ... | | | | | | | | | | |
| 27 | ... | | | | | | | | | | |
| 28 | Benzel Tire | | | | | | | | | | |
| 29 | ... | | | | | | | | | | |
| 30 | | | | | | | | | | | |

FIG. 1 OBSERVATION SHEET

**INSTRUCTION CARD**

MASON TIRE & RUBBER CO., KENT, OHIO

NAME OF PART AND SIZE — SHEETS, SHEET NO.

NUMBER AND NAME OF OPERATION — TIME PER PIECE MIN.

MACHINE NO.

| ITEMS | DETAILED INSTRUCTIONS | ELEMENTARY TIME |
|---|---|---|
| 1. | Put trolley on hook | .09 |
| 2. | Get tire and put on table | .20 |
| 3. | Cement | .11 |
| 4. | Apply first section of chafer | .26 |
| 5. | Get additional chafer | .06 |
| 6. | Apply second section of chafer | .15 |
| 7. | Cut and splice chafer | .08 |
| 8. | Turn under by hand | .15 |
| 9. | Flop tire | .01 |
| 10. | Cement | .10 |
| 11. | Apply first section of chafer | .11 |
| 12. | Apply section section of chafer | .20 |
| 13. | Cut and splice | .08 |
| 14. | Turn under by hand | .16 |
| 15. | Get sidewall | .30 |
| 16. | Apply sidewall | .26 |
| 17. | Cut and splice sidewall | .06 |
| 18. | Roll down sidewall | .21 |
| 19. | Stitch down sidewall | .54 |
| 20. | Flop tire | .01 |
| 21. | Get sidewall | .30 |
| 22. | Apply sidewall | .26 |
| 23. | Cut and splice sidewall | .06 |
| 24. | Roll down sidewall | .21 |
| 25. | Stitch down sidewall | .54 |
| 26. | Stamp and mark | .27 |
| 27. | Put tire on trolley | .14 |
| | Total selected time | 5.02 |
| | 20% allowance | 1.00 |
| | Task time | 6.02 |

WHEN WORK CANNOT BE DONE AS SHOWN, REPORT MUST AT ONCE BE MADE TO MAN WHO SIGNED THIS CARD — DATE 6-24-25 — SIGNED J. Smith

FIG. 2 INSTRUCTION CARD

Due to the stress of economic conditions, which were wholly beyond our control, it was necessary later in the year for our company to make some more radical reductions in the cost of our product. We had four ways whereby this could be accomplished: Arbitrarily reducing the wages of our workmen again; using a cheaper grade of material in our product, for material was still at the wartime prices and any reduction made along that line would have necessarily been in the quality of material used; reducing the sales cost; and reducing overhead.

It was not desirable to make any further wage cuts, in fairness to our employees. In each of the latter three proposed methods, except overhead, it was practically impossible to accomplish any savings. Competition was at its height and, as our product was being sold on a quality basis, it had to be as good, if not better, than that of our competitors. So the matter of using a cheaper grade of material was out of the question. The reduction of sales cost was on the same basis as that of using cheaper material, namely, a competitive one. Instead of being able to reduce such costs, it was necessary to increase them, and this disadvantage had also to be overcome. The matter of overhead had been given every consideration and was already reduced to what we thought was a minimum figure. Even after the additional reduction through increased equipment was made, the resultant figures did not show savings sufficient to guarantee an altogether healthy business situation.

There was only one way to get ourselves out of the difficulty, and that was to turn out more units of product per man employed and stabilize and standardize our methods of paying piece-work rates. We therefore resorted to the use of time and motion studies to accomplish this end.

However, before we could really work out our plan and put it into effect there was a tremendous amount of educational work to be done. Any organization which has in mind attempting to swing into this method of setting accurate piece-work rates by the time study method should bear this point well in mind. We found it necessary first to have our department heads "sold" on the idea that time and motion study methods were the only logical methods for establishing piece-work rates which would pay the workman a fair day's wage for the class of work he produced, and also induce him to give to the company the production they knew they should have in the time expended. To give department heads a better understanding of these matters, a series of dinners was given and speakers from outside, who had had experience with this method, were asked to give us their ideas relating to the success of the method. Round table discussions followed and all questions which arose were thoroughly analyzed.

Along with this educational work of the department heads came also that of getting the workmen to realize the importance of this branch of management. There is always a certain amount of suspicion among workmen when the management endeavors to change a system of wage payment, and we felt the necessity of building up the confidence of our men to the extent that we could go ahead with our plans without having any labor disturbances. So, while having our dinners for department heads, we inaugurated a representative plan of factory co-operation whereby the workers and

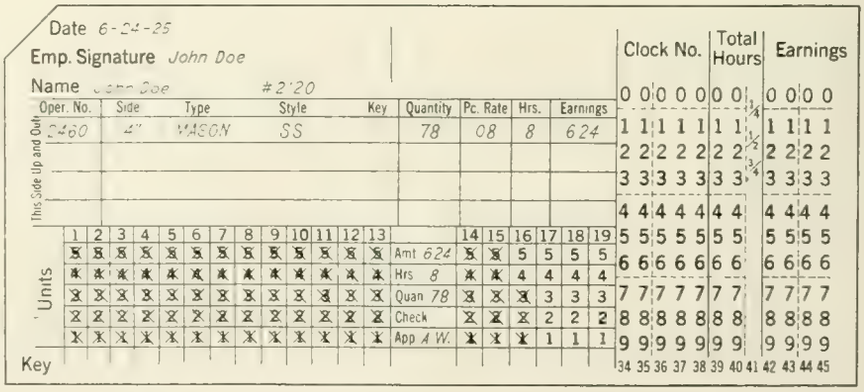



FIG. 3 DAILY TIME CARD AND PRODUCTION CHECK

the management could get together on any problems that affected the workmen in any way, whether it was working conditions in the plant, the amount of money any group was earning, or any grievance or improvement which came to mind. It was truly a workmen's committee, elected by the men for the benefit of the men.

After this committee functioned for approximately three months and had settled various matters of interest to the men, the question of a scientific method of establishing piece-work rates was presented by the management. The suggestion, after much discussion, was favorably received and soon afterward the work was started. We secured the services of a competent consulting engineer to give us an outsider's viewpoint on the various operations for the benefit of both the management and the men.

Work was no more than started, however, when the question arose in the minds of the workmen as to the basis of pay for the various operations after the correct "times" were determined. The object foremost in the mind of the workman is the amount of money he will receive at the end of the week or pay period. Our aim, let me state again, was not that of reducing the amount of the average hourly earnings, but to increase the output per man. With these two points held clearly in mind, we made a survey of all

TABLE 1 COMPARISON OF BASE RATES AND AVERAGE EARNINGS

Per Hour

| Operation No. | Description | Base Rate, Cents | Average Earnings, Cents |
|---|---|---|---|
| 1151 | [illegible] | 81 | 81.3 |
| 1251 | Mass Reliner | 72 | 75.8 |
| 1252 | Milling | 63 to 81 | 75.3 |
| 1351 | Dry Fabric | 66 | 57.9 |
| 1352 | Strip Cord Stock and Ply | 78 | 70.5 |
| 1353 | Strip Fabric Stock | 78 | 82.7 |
| 1354 | Calender Stock | 78 | 68.9 |
| 1355 | Skim Stock | 78 | 58.4 |
| 1356 | Calender Skim Cord | 78 | 78.4 |
| 1357 | Calender Skim Cord | 78 | 72.2 |
| 1358 | Skim Cord | 78 | 71.2 |
| 1359 | Skim Cord with 553 (White) Stock | 78 | 57.9 |
| 1360 | Skim Breaker | 78 | 60.9 |
| 2151 | Cut Cord Plies | 66 4 | 77.7 |
| 2154 | Cut Book Strips | 66 | 68.9 |
| 2161 | Splicing Cord Ply, Mch. | 67.5 | 86.5 |
| 2165 | Splicing Fabric Ply, Mch. | 75 | 86.2 |
| 2166 | Splice and Band Cord Plies | 75 | 76.7 |
| 2167 | Assembling Carcass | 66 | 62.0 |
| 2251 | Insulate Bead Wire | 66 | 70.3 |
| 2252 | Tube and Cover Cl. Beads | 72.6 | 77.6 |
| 2253 | Cutting Square Cl. Beads | 54 | 59.1 |
| 2254 | Rolling S. S. Beads | 66 | 70.9 |
| 2255 | Curing Beads | 84 | 83.1 |
| 2256 | Trim and Buff Beads | 75 | 82.7 |
| 2258 | Truck and Cement Beads | 84 | 81.6 |
| 2259 | Rolling 3 in. Cl. Beads | 66 | 57.9 |
| 2262 | Flip S. S. Beads by Mch. | 66 | 71.2 |
| 2263 | Flip Comb. Beads by Mch. | 66 | 74.2 |
| 2264 | Rolling S. S. Beads by Mch. | 66 | 72.8 |
| 2270-A | Fabric Breads | 76 | 76.4 |
| 2351 | Build Air Bags | 90 | 82.0 |
| 2352 | Curing Air Bags | 96 | 89.9 |
| 2355 | Tubing Air Bags | 72.6 | 75.3 |
| 2153 | Hand Build 6-7-8 in. | 90 | 83.1 |
| 2158 | Mason Jr. Build and Finish Comp. | 78 | 76.8 |
| 2160 | Finish Cords | 78 | 73.8 |
| 2164 | Mason Jr. Drum Build | 78 | 78.0 |
| 2165 | Mason Mch. Band Ply | 84 | 72.8 |
| 2166 | Finish Cords and Balloons | 78 | 57.6 |
| 2167 | Mech. Equipment Band Ply | 78 | 54.6 |
| 2168 | Mason Mch. Band Ply | 84 | 73.8 |
| 2169 | Mason Mch. Mech. Stitched | 84 | 65.1 |

related industries in this district to determine what the other concerns considered a fair day's earnings for similar work, compared it with what men in our organization had been earning, and made adjustments, wherever necessary, after the rates were passed on by the factory committee. These final figures were then used for the various operations and were known as the "piece-work base rates" on which our piece-work rates were set. Thus, it was established that tire builders were averaging approximately $0.84 per hr., tire finishers $0.78 per hr., curing-room men $0.90 per hr., etc. These hourly earnings became our piece-work base rates.

The question of a day rating for a piece-worker, when not working on a piece-work operation or when transferred to some job with which he was unfamiliar was brought up. This matter was also gone over thoroughly and after much discussion it was decided that a 25 per cent reduction on the piece-work base rate should be the hourly rate for these men. This rate was called the "experienced worker's hourly rate." The 25 per cent reduction was used so that there would be sufficient incentive for an experienced man to speed up his production to earn the full amount with additional effort on his part.

In order to make this a little clearer; there are from time to time many changes in the construction or in the mechanical devices used in handling the work, which come about so quickly that it is impossible to establish a piece-work rate on that part of the work immediately. In order to compensate the worker while he is doing this changed work, or until a new time study can be taken, he is paid this experienced worker's hourly rate.

At the same time we determined what our hiring rate for piece-workers would be by the same method of comparison with the other shops in the district, but we realized that while other companies were paying the same scale, or nearly so, this amount was hardly high enough to attract the class of labor we wanted. So we attached an added incentive of one-third of the piece-work rate to the hiring rate, this amount to be added until the worker earned $0.54 per hr., with the time for him to reach this amount limited to a period of four weeks. If the workman made his $0.54 an hr. in a shorter period than four weeks, using the piece-work rates for the unit he worked on, he automatically went on piece-work and received what he made. But if he was unable to earn $0.54 an hr. in four weeks he was taken off that job and tried on another until he found some place where he could earn that amount. If unable to make headway on a job after three trials he was either dismissed or placed on some day-work job, such as trucker or helper.

To explain the above further; our hiring rate for all piece-work operators is $0.36 per hr. If an operator is on piece-work which pays $0.21 per unit, he will receive one-third of $0.21, or $0.07, per unit for all he completes. If he produces 20 pieces in 10 hr. he will receive $1.40 plus his $0.36 per hr., or $5 for his

day's wages. However, should he produce 40 units in 10 hr. at the same piece-work rate, $0.21, his earnings would be $6.40. Therefore his $0.36 hourly rate would no longer apply, for he would be earning in excess of $0.54 per hr. In such a case he would be paid straight piece-work.

Thus, we have three distinct classes into which our wage earners are divided and accordingly compensated:

1. The experienced piece-worker's base rate, by which all piece-work rates are determined. This rate in no instance is a day-work or hourly rate used for any operators.
2. The experienced piece-worker's hourly rate, which is paid an experienced piece-worker when he is working on any job at which he is not experienced, or on work for which no piece-work rates have been established.
3. The hiring rate for productive workers, $0.36 per hr. plus one-third the piece-work rates for the various operations involved.

Too much emphasis cannot be placed on the second class of wage payment, that of the experienced piece-worker's hourly rate, for by this method we are able at all times to control the earnings of our men when piece-workers are put on a day-work job, or on new work at which they are not experienced. We all realize that a man will not work as efficiently or consistently on a day-work job, or on any job paid by the hour, as on a job which carries a piece-work rating. However, if he knows that he will lose money on a change of jobs he will immediately bend every effort to learn his new job so that he can either make his base rate, or nearly so, if it is an established piece-work job, or become so efficient that new "times" can be taken and a piece-work rate established.

## Establishing Standard Times

In many instances our methods of construction have been changed, or a rearrangement of the department is made, which necessitates a change on the "time" for that particular operation. In the past 18 months, after we had completed the major portion of the observations, we set up what we called "standard times" for certain parts of the operations, which may be applied to similar operations, and these standard times are used for any adjustments that become necessary in the changes of methods. These standard times are for such parts of the operation as stopping and starting motors, benzoling plies, setting beads, etc.

Fig. 1 shows an observation sheet of an original time study analysis. Fig. 2 shows a sample of our instruction card as it is presented to foremen and workmen. I might add that, in all of the changes that become necessary in the manufacture of tires and tubes, we do not consider any change of time that does not add or take away more than five per cent of the original time. Otherwise we would be continually making minor changes which would not affect the cost of the product or the earnings of the workmen in the least.

We are using a daily time card, as shown in Fig. 3, throughout the plant for all workmen. This card is also our production check to show the operation on which the operator is working, his production, the hours worked and his earnings. The production, hours and earnings are carefully checked and verified in the pay-roll department, not only for the money verification but also to see that the men are making "task time," that is, producing the full quantity expected in the hours worked. The payroll department then summarizes weekly the records of each department according to the operations, and this summary is used as a guide to maintain "task time" production and average hourly earnings of the workmen. A monthly distribution of labor is then tabulated showing the quantity, hours and earnings of the operations. This is broken down to show the average hourly earnings for the operations throughout the plant, as shown in Table 1.

We are using the time study system of Dwight V. Merrick, the consulting engineer on whom we called to help us work out and apply our new methods.[1]

## Time Allowances

On all preparation work we allow a straight 25 per cent over the selected time, and on all actual productive time we use the scale of machine and fatigue time allowances worked out and adopted for this system.[2] We have found in many instances, in fact in perhaps 90 per cent of our observations, that our selected times are less than the average time which the workman used to complete the unit of production while we were studying his operation. The psychological effect of having a man standing beside him with a watch has a great deal to do with this, as the workman knows the rate will be set on the time taken and he will naturally take a longer time to complete his work than he would if no one were observing him.

Now the reader will be interested to know the results accomplished through the installation of time and motion study in our plant. We have increased production approximately 40 per cent; eliminated so called "bottle necks" where production would not keep abreast of the departments ahead, or behind, giving us an even flow of material throughout the plant; and standardized operations and working conditions; all without reducing the average hourly earnings of the men employed. Maintenance of an equitable rate of pay has been a great aid in keeping the men on our payroll satisfied, and, in addition, in giving us the reputation of fair dealing with our employees. As a result, we have always a waiting list of desirable applicants, men of the class which any firm might well be glad to have working for them.

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[1] This system is explained in "Time Studies As a Basis for Rate Setting," by Dwight V. Merrick.

[2] Reproduced in "Management's Handbook," p. 825. Regraphed in a simpler form in the February 1925 issue of this magazine, pp. 143-4, "A New Graphical Solution for Time Allowances in Task Setting," by Carl G. Barth.

# Keeping Down the Cost of the Factory Dispensary

By M. S. ROSSY

*Formerly Service Manager, John A. Dunn Company*

IN the state of Massachusetts a law was passed a few years ago requiring industrial establishments that employed 100 workers, or more, to maintain a first-aid room. If a factory set apart a room of certain dimensions, equipped it with prescribed materials, and furnished a person experienced in first-aid work to take charge of it, that establishment satisfactorily complied with the demands of the law.

## Installation in One Factory

A recent investigation by a factory employing 600 workers was enlightening with respect to the expense of such a dispensary and changed the opinion of the management regarding the so-called "extravagance." This factory, being financially embarrassed by the construction of new buildings at the time when the dispensary was installed, had chosen to abide by the minimum requirements of the law and had set aside for the dispensary a room no larger than the exact measurements stated. This room, having been previously used for manufacturing purposes, was made with a rough floor and had stained and marred walls. One of the painters of the factory painted the walls and ceiling white in a few hours, and then the appearance of the floor was improved by a covering of linoleum. Running water was provided, additional electric lights were allowed, and a small electric stove was installed for hot water and hot applications. As this was a woodworking factory, chairs, tables, cots and screens were made by the employees at a small cost. By an arrangement with the accident insurance company, expensive equipment, such as cabinets, sterilizer, waste pail, etc., was loaned by that company to be returned if at any time the insurance should be withdrawn. All other equipment, such as bandages, disinfectants, adhesive, etc., was purchased outright from a supply house. The total initial cost was slightly below $100.

The selection of a person to preside over the dispensary was of utmost importance to the factory, as it was felt that a capable nurse would be able to save doctors' bills by attending to minor injuries herself and doing the re-dressings in those instances where a doctor's services had been needed at first. As the factory now under discussion did not wish to assume the expense of a doctor on the payroll, a decision was made to employ a graduate nurse on account of her superiority to a first-aid worker. If a graduate nurse is experienced, she demands high pay, so this factory decided to employ one just out from training, who ought, at least, to be expert in surgical dressings and have some knowledge of the common ailments. The small salary that the factory offered would be offset by the fact that regular employment was provided, no night work required, and vacations allowed on Saturday afternoons, Sundays and holidays. It was not difficult for the factory to find a candidate for the position, a recent graduate, who, in view of the advantages named, was willing to work for $30 a week.

The dispensary soon discovered that it treated on an average 18 cases a day. Of this number, approximately 10 were new surgical cases, six were re-dressings, and two required simply medical aid. About two cases a week were hurt so seriously that it was necessary to call upon a doctor for surgery. The amount of supplies used was small.

On the basis of the expense of supplies, the salary of the nurse, and the expense of electricity for the sterilizer and small stove, the average cost per patient per treatment was found to be about $0.42. In addition to this, there was the loss of 15 or 20 min. of work that the factory had to allow to each time worker treated. (Of the 18 patients, there was a daily average of only seven of them who were not piece-workers.)

Before making this investigation, the factory had been inclined to look upon the dispensary as another liability; after the investigation, it realized that the dispensary was a definite asset. The expense of that "humanitarian" proposition was more than balanced by the money saved. To begin with, there was a decided rebate on the premium asked by the insurance company. Also, the efficient nurse had been able to save doctors' bills, for the employees, educated to expect skilful treatment when they got hurt, would many times have demanded a surgeon if the dispensary had not provided good service. If the factory reckoned the expense of the time lost from work when an employee came to the dispensary for treatment, it also was obliged to take under consideration the time saved *for* work because surgical attention had been immediately available for the hurt employees. Unfortunately, no accurate statistics could be produced to show how many cases of sepsis, involving prolonged absence from work, might have developed if the dispensary had not been on the spot to combat germs with its antiseptics. At any rate, the factory does not care if it cannot reckon the gain here in exact dollars and cents; the money spent comes back with interest.

## The Manager's Testimony

"No, we can't say that we have spent very much on our dispensary," the manager thoughtfully declares. "We didn't have much money to put into it and we really didn't want to spend a dollar for it. But we honestly think that we never made a better investment. Of course, there's no sense in throwing money away, so it helps to know that keeping down the cost doesn't mean holding back the good work."

# CURRENT INFORMATION INDEX
## FOR THE MANAGEMENT

The material indexed in this department is carefully selected by the editors of MANUFACTURING INDUSTRIES from upwards of 100 leading industrial magazines; it also includes the publications of some 50 book publishers and professional societies so far as these are of managerial interest to manufacturing executives. The number at the right of each item is the index symbol according to the Dewey Decimal Classification System. If articles are clipped and filed according to these numbers like subjects will automatically fall together and related subjects will follow in logical sequence. The books and pamphlets indexed can be procured from our publishing house, the Ronald Press Company, or from their respective publishers. Photostat copies (white printing on black background) of any magazine article indexed can be obtained at a *price of 25 cents the page,* by addressing the Engineering Societies Library, 29 West 39th Street, New York City, with whom we have arranged this service. Remittance must accompany the order. When ordering photostats please quote from the index. (1) Title of article; (2) Index number; (3) Name, date, and page numbers of periodical in which the item appears. The editors will be glad to furnish on request additional information and references on important topics concerning the management of manufacturing industries, on industrial buildings and equipment, and on power, material handling, production and other plant machinery and devices.

## Industrial Buildings and Plant Maintenance

### Buildings and Equipment

**E. J. & E. Steel Car Shop at Joliet. 658.2**

*Railway Mechanical Engineer,* Dec. 1925, pp. 769-73. Illus. Description of shop method of organizing to rebuild 12 composite gondolas a day.

**Essential Facts on Textile Mill Lighting. 658.24**

C. M. Snyder. *Manufacturers' Record,* Nov. 19, 1925, pp. 72-3. Illus.

**Is Water Always "Cheap"? 658.238**

K. D. Hamilton, *Factory,* Dec. 1925, pp. 912-16, 938, 940, 942, 984, 986, 988. Sources, treatment, application to processes, and equipment for handling drinking and service water in industrial plants. From the practice of the Geo. E. Keith Co.

**Layout and Design of Chemical Plants on a Philosophical Basis. 658.2**

Crosby Field. *Chemical and Metallurgical Engineering,* Oct. 1925, pp. 794-9. Illus. Method of developing plants in a rational manner which results in the nearest possible approach to the ideal.

**The Modern Manufacturing Plant. Atwater Kent Company Has World's Largest Radio Factory, a Single Story Building With 15 Acres Under Glass. 658.2**

Harold Ashworth. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 7-10. Illus. Excellent lighting, extreme cleanliness, wide column spacing, facility of changing plant layout, and provision of the best production equipment and material handling service are important features of this plant.

**Modern Methods for Temperature Control of Industrial Buildings. 658.25**

Charles L. Hubbard. *National Engineer,* Dec. 1925, pp. 559-62. Illus. Suggestions for the selection, operation and control of heating systems for industrial buildings.

**Paint As An Aid to Illumination. 658.24**

Roy A. Palmer. *Electrical Record,* Dec. 1925, pp. 401-3. Illus. Color and finish of walls and ceilings have a great influence on lighting.

**Southwestern—Carl Leonardt's New Cement Plant at Osborn, O., Now in Successful Operation. 658.2**

E. S. Hanson. *Cement, Mill and Quarry,* Nov. 20, 1925, pp. 9-19. Illus. Description of Southwestern Portland Cement Company's new plant and equipment.

**Which Type of Lighting Best Fits My Production Needs? 658.24**

Ward Harrison and Roy A. Palmer. *Factory,* Dec. 1925, pp. 905-8. Illus. Emphasis upon the proved economy of good light provided by the method which fits the particular requirements.

### Maintenance and Repair

**Maintenance Problems in the Small Plant. 658.58**

Maurice C. Cockshott. *Industrial Engineer,* Dec. 1925, pp. 567-72. Illus. Items having important bearing on production, with suggestions for handling them in the absence of a highly trained organization. Covers, belts, bearings, lubrication, tools and supplies, and use of charts.

## General Management and Policy

### Economics and General

**Conferences, Committees, Conventions and How to Run Them. 65**

Edward Eyre Hunt. Harper and Bros., New York. 218 pp. $2.50. Starting with the fact that many conferences, committee meetings and conventions are poorly organized and accomplish but little by way of practical result, the author has made a study of procedure of such gatherings and brought together many helpful suggestions and much detailed information. While this experience is drawn principally from large bodies, the methods are applicable to those that are small. The practical point of view taken is that the preliminary work and planning should seek to create "an atmosphere for fruitful discussion rather than the adopting of a fighting code." The book is well worth the reading of anyone who has to deal with the work of organized bodies of this kind, whether as officer or member.

**Current Economic Problems. 33**

Walton H. Hamilton. University of Chicago Press, Chicago. Third Edition. 960 pp. $4. (postage extra). A series of authoritative readings in the control of industrial development drawn from a wide variety of sources. Treats many phases of the following general topics: Problem of control of economic activity; antecedents of modern industrialism; the industrial revolution; problems of the price system; problems of the business cycle; railway regulation; capitalistic monopoly; population; economic insecurity; trade unionism; control and legal institutions; control and taxation; comprehensive scheme of reform; control of industrial development.

**Effective Business English. 651.74**

Alta Gwinn Saunders. The Macmillan Company, New York. 603 pp. $3. Intended both for college text and general business use. Treats of the nature and make up of business letters. The sales letter—its selling and language qualities; analyzing the factors and constructing the letter; influencing thought and action; the mail order letter. Analyzes and presents the important factors of many types of business letters: Inquiry, orders and acknowledgments, credits, collections, claims, adjustments, applications, sales presentation, sales follow up, preparation of reports.

**How to Write Business Letters. 658.75**

John A. Powell. University of Chicago Press, Chicago, 192 pp. $1.50. A small book intended for the man who dictates letters and for his stenographer who transcribes them. It deals with those factors which make a letter persuasive and convincing rather than with a "punch." Numerous form letters are presented and such practical points as capitalization and punctuation are thoroughly discussed. An extensive appendix gives hints on the mechanics of letter writing.

**Influence of the Interest Rate on the Business Cycle. 338.97**

Carl Snyder. *American Economic Review,* Dec. 1925, pp. 684-99. The questions considered are: What are the typical and dominant interest rates of the country; how much do they vary; how much influence has this variation on the changes in the trade cycle?

**Life of Elbert H. Gary. 92**

Ida M. Tarbell. D. Appleton and Co., New York. 361 pp. $3.50. A welcome contribution by a forceful and capable writer to the series of biographies of American business and industrial leaders. Written out of the knowledge gained from many personal conversations with Judge Gary and a large group of prominent men who knew him intimately, from personal investigation of the public and private files of the United States Steel Corporation, and from a study of correspondence, technical data and other important papers in the Congressional and other libraries. Traces the life of the present chairman of the board of the world's largest manufacturing corporation from boyhood to the present, stressing especially those events having to do with the growth of a new era in American industry, and the prominent part which Judge Gary had in helping to shape present-day big business.

**A New Departure in Engineering Education. 6(07)**

Harold Pender. *American Institute of Electrical Engineers Journal*, Nov. 1925, pp. 1208-10. University of Pennsylvania offers course requiring completion of two years of college courses followed by two years of engineering courses to up-grade the quality of engineering graduate.

**Profits. 339**

William Trufant Foster and Waddill Catchings. Houghton Mifflin Co., New York. (For the Pollak Foundation for Economic Research.) 465 pp. $4. Takes up the important economic question: "Why is it impossible for the people, as consumers, to acquire and enjoy all the commodities which, as producers, they are perfectly able and willing to make?" After laying down the fundamentals of the problem, the author presents an analysis of the necessity of profits and losses, the amount and distribution of profits, the functions of prices and profits, and money and profits in relation to consumption. For the best *adverse* criticism of this book a prize of $5000 is offered.

**A Systematic Scheme for an Employment Policy. 331**

Dr. Berger. *International Labour Review*, Nov. 1925, pp. 634-49. Scheme suggested by a ministerial counsellor in the German Federal Ministry of Labor to restore equilibrium between labor supply and demand.

**The Use of Cost-of-Living Figures in Wage Adjustments. 658.32154**

Elma B. Carr. U. S. Dept. of Labor, Bureau of Labor Statistics, Bulletin No. 369. 506 pp. $0.65. Cost-of-living figures that have been used in wage adjustments, how used, and influence on wage established by the adjustment. Covers federal boards and commissions, state and municipal agencies, state arbitration boards, minimum wage boards, industrial agencies and individual companies. Includes extensive bibliography.

**Women Workers and the Minimum Wage. 658.32156**

Mollie R. Carroll. *American Federationist*, Dec. 1925, pp. 1155-8. Unfortunate aspects of the recent decision against the unconstitutionality of the Arizona law.

## Management

**Business Organization and Management. 658**

Henry P. Dutton. A. W. Shaw Co., Chicago. Flexible binding. 545 pp. $6. Treats the subject primarily from the standpoint of procedure rather than of organization theory. Covers the following topics: Typical business activities; scientific management; organization; ownership; co-operative enterprises; opportunity in business; promotion; capital; financial management; accounting, cost accounting and executive control; credit; collections; banking; insurance; forecasting; manufacturing; production control; purchasing; the office; marketing; retailing; selling and advertising; labor; wages; executive leadership; and the art of handling men.

**Engineering Research—An Essential Factor in Engineering Education. 658.57**

C. Edward Magnusson. *American Institute of Electrical Engineers Journal*, Nov. 1925, pp. 1243-5. Broad and effective plan for co-operation between industries and colleges is suggested.

**Getting the Most Out of Your Machine Tool Dollar. 658.27**

William Bailey. *American Machinist*, Dec. 10, 1925, pp. 917-20. Policy of the Hoover Company which is to sell obsolete machines second hand, if a market can be found within 6 months. If not, the machinery is junked.

**Hand Labor and Machinery as Producers. 658.5**

Rhodes Polleys. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 11-12. Develops a set of simple formulas for their economic comparison.

**How the Automotive Industry Selects Equipment—III. 658.27**

*Machinery*, Dec. 1925, pp. 274-6. Illus. Small tools, records of performance, ground-thread taps, twist drills, milling cutters, reamers, broaches.

**How the Bakelite Corporation Effectively Manages Organized Research. 658.57**

A. V. H. Mory and Leon V. Quigley. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 13-16. Illus. Methods by which the company develops uses, improves technique and plans equipment for its customers in the application of bakelite to manufacturing purposes. The organization and its functions.

**Measurement of Engineering Work. 658.5**

Tyler G. Price. *Electric Light and Power*, Oct. 1925, pp. 15-17, 84. Illus. A comprehensive and effective system used by the Commonwealth Edison Co. to measure the work performed by its engineering department.

**Modernizing a Boxboard Mill. 658.5**

H. G. Ingraham. *Chemical and Metallurgical Engineering*, Oct. 1925, pp. 783-7. Illus. Description of a scheme of technical and mechanical reorganization recently put into effect at the National Paper Products Co. plant at Stockton, Cal.

**$115,000,000 Profit in 14 Years. 658**

A. Motelle. *Automotive Industries*, Dec. 10, 1925, pp. 967-71. Illus. Financial history of the Studebaker Corporation.

**Organizing for Production in the Cotton Manufacturing Industry. 658.5**

Kenneth Mosher. Paper before Textile Section, American Management Association New York.

**A Program for 1926. 658**

L. P. Alford. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 5-6. Outline of the most important developments anticipated in the management field during the coming year.

**Progress in Management Engineering. 658**

Management Division, American Society of Mechanical Engineers, *Mechanical Engineering*, Dec. 1925, pp. 1119-20. Report of the Executive Committee of the Management Division of the American Society of Mechanical Engineers.

**Team-work by Sales and Manufacturing Departments. 658**

George C. Miller. *Printers' Ink*, Dec. 10, 1925, pp. 3-8, 180, 181, 182. Methods used by the Dodge Manufacturing Corp. to foster team-work. An attempt is made to have everybody in the organization adopt the selling viewpoint.

**These Policies Cut Both Production and Selling Costs. 658**

Thomas C. Sheehan. *System*, Dec. 1925, pp. 707-9. Illus. Methods whereby the Durham Duplex Razor Co. has been able to iron out seasonal humps and slumps.

**What Management Has Done for Us. 658.5**

F. L. Hutton. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 51-4. Illus. Extensive changes in manufacturing methods based on time studies and with adequate wage adjustments accomplish remarkable results in improving production and reducing costs at the Mason Textile Machine Co. plant.

# Power Generation and Transmission

## Fuel

**Coal Distilling. 662.6**

G. Cantieny. *Engineering Progress*, Nov. 1925, pp. 349-52. Illus. Favorable results obtained at the Mathias Stinnes I/II Colliery.

## Power Plant and Equipment

**Ball Bearing Electric Motors. 658.26**

T. C. Delaval-Crow. *Machinery*, Dec. 1925, pp. 265-9. Illus. Advantages of ball bearings for motors, and methods of mounting and lubricating.

**Universal Type Motors. 658.26**

L. C. Packer. *American Institute of Electrical Engineers Journal*, Dec. 1925, pp. 1319-23. Illus. Description, ratings, limitations, design features, and successful applications to industrial uses.

## Power Plant Operation

**Coal Handling and Boiler Operation at Northern Paper Mills. 658.26**

H. W. Gochenour. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 23-4. Illus. Methods by which the Green Bay, Wis., plant of the Northern Paper Mills accomplished a reduction in power costs. Layout and equipment for low cost coal handling.

**Brush and Commutator Maintenance. 658.581**

E. S. Howe. *Industrial Engineer*, Dec. 1925, pp. 575-81. Illus. Important things to watch for and methods of checking them in case of commutator trouble.

**Getting the Best Results from the Small Power Plant. 658.26**

Ralph S. Twogood. *Industrial Management,* Dec. 1925, pp. 323-30. Illus. Making steam; heat transfer; plant design; instruments; operation and supervision of plants; education of operators; results obtained from supervision.

**The Executive Control of Steam Costs. 658.26**

F. M. Gibson. *Industrial Management,* Dec. 1925, pp. 346-50. Illus. Need for accuracy; ratio of input to output; fuel values; check-up of heat balance; operating cost records; the small power plant.

**The Fallacy of "Dead Reckoning" in Power Plant Operation. 658.26**

Francis Juraschek. *Industrial Management,* Dec. 1925, pp. 362-6. Illus. $CO_2$ percentages, flue gas temperatures, rates of steam flow, volume of air to support combustion, etc., should be carefully and constantly checked-up. Typical instances of savings.

**Guarding the Oil Engine's Cooling Water. 658.26**

*Oil Engine Power,* Oct. 1925, pp. 583-8. Illus. Means and methods for protecting jacket water circulation and avoiding scale.

**High Efficiency in the Use of Steam. 658.26**

*Power,* Dec. 1, 1925, pp. 846-7. Illus. Advantages and economies in the adoption of the steam turbine in plants requiring both power and process steam.

**How to Reduce Industrial Power Costs. 658.26**

H. A. Woodworth. *National Engineer,* Dec. 1925, pp. 573-4. Suggestions on how to improve economy in industrial power plants by comparatively simple means.

**Iron Mountain Plant Makes Power from Wood Waste. 658.26**

*Power Plant Engineering,* Dec. 1, 1925, pp. 1186-94. Illus. Methods for burning sawdust, wood, gas, oil, charcoal, in one of the Ford plants. Steam for power and kiln drying is produced.

**Overcoming the Handicap of Haphazard Growth in a Power Plant. 658.26**

J. P. Doolan. *Industrial Management,* Dec. 1925, pp. 376-80. Illus. Boiler room and engine room changes that improve power performance.

**Records Cut Maintenance Costs—I. 658.26**

F. A. Westbrook. *Electrical Record,* Dec. 1925, pp. 394-6. Illus. Data on motors and meters kept by S. D. Warren Co., paper manufacturers, are cutting operating expenses by disclosing repeated troubles and costly power losses.

**Some Examples of Possible Savings in Industrial Power Plants. 658.26**

Andrew F. Sheehan. *National Engineer,* Dec. 1925, pp. 563-5. Seven cases where substantial savings were made through improved operation of industrial power plants.

**Steam-Power in Its Relation to the Development of Water-Power. 658.26:621.2**

Richard C. Powell. *American Institute of Electrical Engineers Journal,* Dec. 1925, pp. 1291-5. Illus. Economic phases of both considered. Simple method of finding minimum cost of power for an assumed water power development with auxiliary steam power.

**Using Oils and Greases for Industrial Lubrication. 621.89**

Frank E. Gooding. *Industrial Engineer,* Dec. 1925, pp. 558-63. Illus. Sources of materials, compounding, manufacture, applications. Use of graphite with lubricants, its action on scored bearings. Effect of speed on choice of a lubricant.

**Where Gravity Helps the Power Bill. 658.281**

Matthew W. Potts. *Industrial Management,* Dec. 1925, pp. 351-4. Illus. Handling coal and ashes at the Hammermill Paper Co. plant, Erie, Pa.

**Why Management Is Responsible for Excessive Coal Bills. 658.26**

Thomas A. Marsh. *Factory,* Dec. 1925, pp. 891-3, 988. Illus. States that the reason for the waste and losses in power plant operation is lack of information among executives.

### Power Transmission

**The Control of Mechanical Power Transmission—IV. 658.262**

William Staniar. *Industrial Management,* Dec. 1925, pp. 338-43. Illus. Transmission applications; unit or group driving systems; babbitted and anti-friction bearings; idler systems.

**The Tension Ratio and Transmissive Power of Belts. 658.262**

C. A. Norman. *Mechanical Engineering,* Dec. 1925, pp. 1111-3. Illus. Report on investigation into the increase of transmissive power with slip conducted on rubber, leather and fabric belts. In general the transmissive power of belts on cast iron pulleys shows a tendency to increase with the slip.

## Marketing and Distribution

### Advertising

**How Advertisements Are Built. 659.1**

Gilbert P. Farrar, D. Appleton and Co., New York. 296 pp. $3.50. Written for business men and for students of advertising. Explains the principles of magazine, newspaper, folder and circular advertisements. Shows what a good advertisement is. Outlines the art of expression under the heads of attracting attention, creating interest, arousing desire, developing conviction, and producing action. Points out the factors of impression and shows how to treat them—size, borders, pictures, text, trade name. Finally, tells how to build advertisements. Amply illustrated by effective samples of good advertisements.

**The Organization of an Advertising Department. 659.1**

S. E. Conybeare. *Advertising and Selling Fortnightly,* Dec. 16, 1925, pp. 25, 54-55. Practice and methods of the Armstrong Cork Co.

### Selling

**Credit Analysis. 658.882**

W. C. Schluter, Prentice-Hall, Inc., New York. 439 pp. $5. Comparative study of reports and methods used by many of the foremost bankers and credit men. How credit information is obtained, and points used in reaching a judgment on credit risk. How bankers, accountants and mercantile credit men determine the safe and profitable proposition between borrowed and owned working capital. Importance of budgets in credit analysis is described and an outline is given for estimating external influence on income. The chapter headings cover these subjects: Approach to credit risks; creditor's experience; interchange reports; credit risks and the business cycle; neglected elements in credit; financial statements; source of capital; uses of capital; supply of working capital; productivity of assets; rate of fixed expansion; management of working capital; credit analysis and principles of budgeting; indicators of collections.

**How to Reduce the Cost of Selling. 658.8**

A. G. Frost. *National Association of Cost Accountants Bulletin,* Dec. 1, 1925. pp. 239-63. Methods of the Wahl Co. whereby they have been able to substantially reduce the cost of selling their products.

**How We Inject the Operating Point of View Into the Sales Program. 658.8**

A. M. Williamson. *Factory,* Dec. 1925, p. 899. Methods developed and used by the Acheson Graphite Co.

### Packing, Shipping, Transportation

**Co-ordination of Railroad and Motor Truck in Freight Handling. 656.124**

Joseph L. Scott. *Society of Automotive Engineers Journal,* Dec. 1925, pp. 607-8. Illus. Pennsylvania Railroad successfully handles less-than-carload freight by contract with Scott Bros. who serve 469 towns in four states by motor truck.

**Electric Truck Facts. 656.124**

B. J. Martin. *Electric Light and Power,* I—Nov. 1925, pp. 68, 104, 106, 108. Illus. Data from electric service companies' use of electric transportation. II—Dec. 1925, pp. 68, 107. Illus. Electric trucks in the service of the Milwaukee Electric Railway and Light Co.

**More Facts on Electric Trucks. 656.124**

*Electrical Record,* Dec. 1925, pp. 397-9. Illus. American Railway Express makes studies and keeps operating records on costs and space factors.

**Railway Men Study Freight Claim Prevention Methods at Laboratory. 658.7884**

*Barrel and Box,* Nov. 1925 pp. 43, 45, 47. Illus. Testing machines described and results of investigations shown.

**Wooden Boxes from the Forest to the Packing Room. 658.7884**

Harry N. Knowlton. *Barrel and Box,* Nov. 1925 pp. 30-2. Illus. The $21,000,000 avoidable annual waste in box and crate construction is illustrated by several examples of savings brought about.

# Material Handling and Production Control

## Material Control

**Buying Finishing Materials. 658.7**

*Wood Working Industries,* Nov. 1925, pp. 18-19, 34. Need of grading rules for these products.

**Buying to Specifications. 658.7**

*Electric Light and Power,* Dec. 1925, pp. 15-17. Illus. Outline of methods and results produced at the Detroit Edison Co.

**Glues for Use With Wood. 668.31**

*Wood Working Industries,* Nov. 1925, pp. 31-2. Discussion with comparative table.

**Testing Lumber for Moisture Content. 658.772:674**

Thomas D. Perry. *Wood Working Industries,* Nov. 1925, pp. 22-5. Illus. Before, during and after kiln drying. Suggestions for purchasing lumber under moisture content limits.

## Mechanical Handling

**An Efficient Material Handling System in this Garnet and Silica Sand Plant. 658.281**

*Pit and Quarry,* Dec. 1, 1925, pp. 93-8. Illus. Methods in the Grove Stone and Sand Co. plant.

**Handling Products in the Squibb Plant. 658.281**

George E. Hagemann. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 35-8. Illus. E. R. Squibb Co. has erected a new 13-story building at Brooklyn, which was planned from the standpoint of co-ordinated material handling and processing. Outline of plan and description of methods.

**The Hidden Costs in Handling Bulk Materials. 658.281**

*Factory,* Dec. 1925, pp. 896-9, 966, 968, 970, 972, 974, 976, 978. Handling coal and ashes is a simple matter now; conveyors pave the way to lower handling costs; monorail conveyor cut our handling costs 29 per cent; $7.805.47 saved annually by improved handling methods.

**How to Save Money in Your Lumber Yard—IV. 658.281**

H. S. Bartholomew. *Wood Working Industries,* Nov. 1925, pp. 16-17. Methods of reducing handling costs of lumber.

**Reclaiming Materials from Storage Efficiently and Economically. 658.281**

*Pit and Quarry,* Nov. 15, 1925, pp. 89-91. Illus. Methods at the Wyoming Sand and Stone Co. plant.

**Reducing Sand Handling Costs. 658.281**

*Iron Age,* Nov. 26, 1925, pp. 1437-9. Illus. Material handling equipment at the No. 1 Plant of the Allis Chalmers Manufacturing Co. Conveyors unload incoming cars. Elevators and dump trucks move sand from storage to mixer.

**Progress in Materials Handling. 658.281**

Materials Handling Division, American Society of Mechanical Engineers. *Mechanical Engineering,* Dec. 1925, pp. 1116-9. Review of the work done by the Materials Handling Division of the American Society of Mechanical Engineers, and suggestions for future activities.

## Production Methods and Control

**Cement Industry Offers Big Saving By Oxy-welding. 665.882:666.94**

*Cement, Mill and Quarry,* Dec. 5, 1925, pp. 22-6, 28, 30. Illus. Examples of equipment produced and repairs made by the process.

**Cleaning Casting Hydraulically Proves Economical. 621.72:658.5**

E. C. Barringer. *Iron Trade Review,* Nov. 19, 1925, pp. 1267-9, 1318. Illus. Allis-Chalmers Mfg. Co. installs new system which enables two men to do the work of 60.

**Economy in Producing Sand and Gravel. 658.5**

George Ransom. *Pit and Quarry,* Nov. 15, 1925, pp. 39-44. Illus. Balanced operations at the Iron Ledge Co. plant.

**An Effective Production Control System—II. 658.5**

John J. Swan. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 39-43. Illus. Methods by which the Kelly Press Division of the American Type Founders Co. has established direct control over production, inventory, and handling.

**Even-Flow Production: What It Can Mean to the Small Plant. 658.5**

Frank J. Lynch. *Factory,* Dec. 1925, pp. 909-10, 959. Advantages of even flow of production through manufacturing processes of a small plant. From the experience of the Sun Tube Corporation.

**Heating by Electricity in the Chemical Industries. 658.27:668**

Robert M. Keeney. *Chemical and Metallurgical Engineering,* I—Oct. 1925, pp. 805-9. Illus. Applications to many industrial processes. II—Nov. 1925, pp. 855-9. Illus. Various designs of heaters and their uses. Heating control and purchase of equipment.

**Management of Lumber Dry Kilns. 658.5:674**

Thomas D. Perry. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 45-50. Illus. A system by which handling and production can be materially simplified and reduced in cost in the lumber industry.

**Save Worn and Broken Parts by Oxy-Acetylene Welding. 665.882**

T. C. Fetherston. *Barrel and Box,* Nov. 1925, pp. 28-9, 51. Illus. Machinery and equipment can be readily reclaimed when damaged.

**Temperature Control in Japanning Ovens. 658.27:667.8**

*Brass World,* Nov. 1925, pp. 389-90. Illus. Its possibilities and advantages.

# Employment and Personnel Management

## Employment and Training

**A Self-Supporting Apprenticeship System. 658.3861**

*Machinery,* Dec. 1925, pp. 326-8. Illus. Features of the system used by the Marion Steam Shovel Co. Figuring costs; teaching economics.

**We Train Foremen to Think. 658.386**

Glenn L. Gardiner. *Factory,* Dec. 1925, pp. 894-5, 978. Illus. Methods used by the Oakland Motor Car Co. to develop foremanship.

## Personnel

**Essential Personnel Records. 658.3**

Bryce Haynes. American Management Association, New York. Pamphlet. 44 pp. Report of the Committee on Personnel Technique of the American Management Association.

**Measuring and Grading the Supervisory Forces. 658.3**

W. D. Stearns. American Management Association, New York. Pamphlet. 72 pp. Report of the Committee on Supervisory Forces of the American Management Association.

## Health and Safety

**Aeronautic Safety Code. 629.13:614.8**

Society of Automotive Engineers, Inc., New York. Pamphlet. 52 pp. Tentative American standard approved by the American Engineering Standards Committee, by the Bureau of Standards and Society of Automotive Engineers, Inc. The intention has been to formulate canons of good practice which should be helpful in utilizing experience of the past by indicating proper practice and eliminating unnecessary hazards. Airplane design, fabrication and tests, signals and signalling equipment, airdromes and airways, operation of airplanes, qualifications of airmen, and general requirements of balloons and parachutes are considered.

**Analysis of 300 Accidents in Wood Working Factories. 658.3823**

Herbert L. Reid. Dept. of Labor, state of New York, Special Bulletin No. 139. With suggestions as to safe practice and suitable machine guards.

**The Reduction of Accidents to Employees. 658.3823**

*Railway Engineering and Maintenance,* Nov. 1925, pp. 450-4. Illus. Handling materials, falls, hand tools, the personal factor.

**Relation of Safety and Production. 658.3823**

Robert H. Luckenbach. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 25-8. Illus. Methods by which the Edward G. Budd Manufacturing Company makes safety a management responsibility and has reduced the accident rate.

## Remuneration

**Our Wage Payment Recognizes Cost of Living, Length of Service, Efficiency. 658.32**

J. A. Riley. *Factory,* Dec. 1925, pp. 917-8, 980. Methods of the Palmolive Co.

# Financial Control and Accounting

**Budgeting the Textile Industry. 658.14**

Carey F. Thiel. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 29-34. Illus. Complete procedure in working up, adopting and establishing a comprehensive budget; the organization necessary, and methods of getting the plan across.

**Budgeting—My Experience with Many Industries. 658.14**

H. I. Shepherd. *System*, Dec. 1925, pp. 699-701, 742. The experience of the author who is vice president of the Guardian Trust Co., in investigating budget methods and the results in numerous industries.

**Elements of Business Finance. 658.14**

Joseph H. Bonneville. Prentice-Hall, Inc., New York. 412 pp. $5. Not only describes different means of starting a company, but shows how and why to choose between a partnership, corporation, "trust" or a personal proprietorship plan. Various methods generally used to raise funds, secure capital and to meet indebtedness. Discusses forms of stocks and bonds and their comparative advantages and limitations, from the standpoint both of the borrower and investor. Actual plans that can be followed in small undertakings as well as in large mergers are described. of particular interest to business men is the discussion on the legality of partnerships, stock companies and corporations. Table of contents: Starting a business; forms of business organization; limited partnerships; management of corporations; stock; borrowed capital; mortgages and mortgage bonds; extinction of bonded indebtedness; financial plan; working capital; selling securities and underwriting syndicates; intercorporate relations; income and its management; surplus and dividend policies; effects of credit policies; business finance and the banks; illegal combinations; failures and reorganizations and others.

**Principles and Scope of Budgeting. 658.14**

Henry Bruere. Pamphlet, 16 pp. American Management Association, New York. Briefly covers its topic for public utilities, banks, insurance companies and department stores.

**Scope of Financial and Industrial Investigations. 658.1**

Arthur Andersen. MANUFACTURING INDUSTRIES, Jan. 1926, pp. 17-22. Conditions and sources of data; change in ownership; place of financial investigation and appraisal; internal investigations; appraisal, legal, research and accounting data and importance of such data.

**What is Your Capital Ratio? 658.14**

C. R. DeLong. *Chemical and Metallurgical Engineering*, Nov. 1925, pp. 853-4. Illus. This factor is a valuable index to profits as well as a distinctive characteristic of the chemical engineering industries.

## Accounting and Cost Finding

**Computation of Good-Will Profits. 657.4236**

C. J. Foreman. *American Economic Review*, Dec. 1925, pp. 652-64. Discussion of the different methods of computing the various profits of good will in business.

# New Industrial Equipment

**Flexible Coupling. 621.825**

To correct unavoidable errors of shaft misalignment in all classes of connected machinery and allow free end float to two connected shafts. Consists of six parts, two hubs having an external gear on each, meshing with internal gears in two sleeves which are bolted together, and two aligning rings which are fitted in the two sleeves. If the two shafts are out of alignment, the sleeve assumes a neutral position with a perfectly formed and lubricated bearing on the spherical surface of each shaft hub. An all metal gear type of coupling, lubricated and self aligning. Unusual strength, greater in all cases than the connected shafts. Complete protection from dust and dirt. Operates equally well in either direction, on continuous or reversing service and at high or low speeds.

All parts made of high carbon forged steel, and are interchangeable. Sleeve bearings and gear teeth are entirely submerged in oil. Sizes: From 1½ to 5 in., by half inches, and from 6 to 12 in. by inches. Made by Poole Engineering and Machine Co.

**Gasoline Hoist. 621.86**

Made by American Hoist and Derrick Co. Has gear drive instead of chain drive. Power is transmitted directly to the pinion shaft of the hoist, which is between the two rear drums, and from there to the friction gears, by at least two teeth—one to each adjoining friction gear—whereas on the old arrangement power was transmitted to the rear drum and from there to the rest of the drums by only one gear tooth.

Hoist and engine are mounted on a cast iron bed plate, insuring rigidity and absolute alignment of gearing, shafting and bearings. Supplied with the drum equipment of the regular "American" steam hoisting engine. By means of the hoist unit system no greater number of drums than present requirements call for, need be purchased as future growing requirements can be taken care of by bolting one additional drum at a time to the front of the hoist. Three sizes: No. 24.32 G, 32 hp. engine. drums 10 in. diam. by 20 in. long, capacity 4000 lb. at 160 ft. per min; No. 28.60 G, 60 hp. engine, drums 12 in. diam. by 23½ in. long, capacity 6000 lb. at 200 ft. per min; No. 111.75 G, 75 hp. engine, drum 14 in. diam. by 27 in. long, capacity 8000 lb. at 185 ft. per min.

Gasoline hoists combine the cleanliness of the electric hoist with greater portability, can be used where electric power is not available, where the water supply is unsuitable for use in steam boilers, or where there is no boiler water at all. A licensed engineer is not required.

**Light Duty Hand Lift Truck. 621.85**

Built for speed and ruggedness; 2000-lb capacity; easy lift; alemite lubricated; furnished with 3 or 4 roller bearing wheels, 6, 7, or 9 in. diam.; high or low lift respectively $1\frac{13}{16}$ in. and 2¾ in. elevation platforms of various sizes, from 17 by 32 in. up to 25 by 48 in. Trade name "Blue Streak." Made by Cowan Truck Co.

**Magnetic Switch for Woodworking Machines. 621.3173**

Enclosed magnetic switch (CR-7006-S-3), made by the General Electric Co. for woodworking applications where frequencies higher than 100 cycles are necessary. A special coil and magnet frame construction is used, without increasing the overall dimensions of the switch. The rating of the switch varies according to the frequency of the circuit on which it is used: at 120 cycles, it will be operated on 220 volts; at 150 cycles, on 275 volts; at 180 cycles, 330 volts, or any other corresponding intermediate voltage and frequency. The switch is built in the two-pole form for the convenience of machine builders in conserving space and providing one disconnecting switch for all motors.

**Oil Burner and Preheater. 669.8**

In welding many castings, preheating is necessary to neutralize expansions and contraction strains, or to effect economy of gases. Large castings will absorb a large amount of heat, so a great gas saving can be made by first preheating the entire piece. The Alexander Milburn Co. has placed an oil burner and preheater on the market for this purpose.

The Milburn oil burner and preheater is primarily designed to give maximum combustion and greatest heat in the quickest possible time, thereby reducing overhead and resulting in greater output from men and machinery. It is of the atomizing type utilizing economically the cheapest grade of crude, fuel, kerosene oil or distillate and compressed air under pressure varying from 50 to 100 pounds. The air supply line serves two purposes. While furnishing a direct flow to the burner, the air also maintains a similar pressure in the oil storage tank, creating a greater velocity in the oil feed line thus insuring a positive and uniform flow of both oil and air. Immediately upon opening the valves the gas at the burner can be ignited and the work at hand can be started. Carbonization and oxidation are eliminated.

**Six-Ton Hy-Lift Truck. 621.86**

A new Baker 6-ton Hy-Lift truck is being marketed by the Baker-Raulang Company for use in steel stamping, automotive and other industries to change dies conveniently and at low cost.

The main frame consists of two 8-inch and two 9-inch channels. The vertical track on which the roller carriage runs consists of two 8-inch nickel-steel special I-beams. The power plant employs a Baker totally enclosed series motor driving through a worm reduction and full floating axle shafts. The hoist is of the 2-cable type and the drums are driven by a compound wound motor through a combination worm and planetary reduction.

When dies are changed by the hy-lift truck method they are conveniently stored on roller racks three or four tiers high and quickly transferred to and from the truck platform. Heavy dies can be stored on the floor on skids or on blocks so that the hy-lift can run underneath the dies and pick them up.

GERRARD
Uni-Lastic
STOWAGE

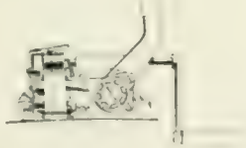
"The Tie That Binds"

# Gerrard Uni-Lastic Stowage

*Approved by the Western Weighing & Inspection Bureau. See W. W. & I. B. Bulletin No. 606.*

## What Is It?

A method of car-loading that ties the load into two flexible units of such size that they absorb the shocks and impacts of train movement and switching, It allows a slight compensating movement of the whole load in the car and permits enough elasticity in the load itself to cushion transportation shocks and prevent damage either to merchandise or rolling stock.



*One of the Gerrard group of Wire Tying Machines— the well known Model "B" for light packaging. Uses wire, 12 gauge, or smaller. Ask us how to make safer single-package shipments.*

## How Is It Done?

Four strands of 8 gauge wire are "draped" around the inside of the car and spaced with spacer wires according to the height of the load. After the load is placed, the wires are drawn tight with a Gerrard Little Giant Wire Tying Machine. "The Tie That Binds" is made, and the load is ready.

## What Does It Accomplish?

Gerrard Uni-Lastic Stowage accomplishes the safe carriage of merchandise.

It reduces dunnage to 30 pounds and eliminates the use of spikes, nails or timber bracing.

It saves $2.00 to $4.00 per car in loading costs for the type of shipment illustrated.

*It reduces damage to both merchandise and rolling stock.*

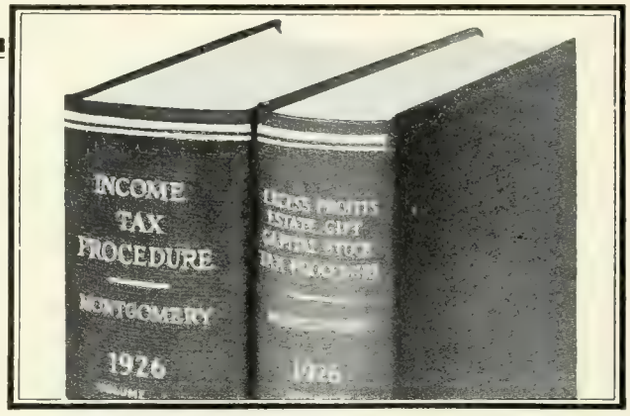
## GERRARD WIRE TYING MACHINES CO.

**1943 South 52nd Avenue** :: :: **CHICAGO, ILL.**

*Now Ready*

## Montgomery's Manual of

# Tax Procedure for 1926 (10th Annual Edition)




CURRENT tax problems have developed to the point where preparing each year's return is only part of your work. You must now be prepared also to handle appeals, hearings, and reviews as necessary. When important decisions are handed down which may mean big refunds, you want to be in position to act promptly, and before it is too late, to recover anything due your company or your clients.

### Offers the Counsel of an Acknowledged Authority

Montgomery's 1926 manual enables you to meet these changed conditions. It is the personal work of Robert H. Montgomery, Counselor-at-Law and member of the firm of Lybrand, Ross Bros. & Montgomery. The information which it contains is based upon sound procedure as determined by decisions of the courts and Board of Tax Appeals and upon Treasury regulations and rulings issued during ten years' experience under five tax laws.

This edition, because of the increasing amount of material which must be presented, is divided into two volumes. The first is devoted to the Income Tax; the second treats the Excess Profits, Estate, Gift, and Capital Stock Taxes.

> The value of this 1926 manual *will not be lessened or affected by the passage of the new tax law* during 1926. You need have no hesitancy in availing yourself of its interpretative counsel regarding questions now pending or of the precautions and protection which it supplies for making returns for the past year's operation.

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Mr. Montgomery's complete treatment of cases and procedure before the Board of Tax Appeals *alone* will make his manual a necessity to every corporation official, lawyer, banker, and accountant.

Already more than 1,000 decisions have been handed down by this Board. Many of the changes in Treasury Department rulings which these entail are *nothing short of revolutionary.* Thousands of returns are affected.

For this volume, Mr. Montgomery has digested and arranged according to subjects every case decided. On each decision in which questions of principle, or important, interesting, or novel points are involved, he gives in full his personal comments. This service cannot be *duplicated elsewhere.*

Only in this manual, too, do you get constructive and detailed explanations of what *must* be done in presenting cases before the Board, together with helpful suggestions regarding what *should* be done.

### The Only Complete Manual of the Excess Profits Tax

During the past year, there have been handed down decisions of far-reaching importance to every corporation which paid excess profits taxes. One, made public only a few weeks ago, may involve refunds of hundreds of millions of dollars.

In view of these developments, and in view also of the fact that most of the cases now up for appeal involve the excess profits tax, a book of procedure under it becomes vitally necessary. Mr. Montgomery has brought together for his manual *everything to date* regarding this tax—the law, regulations, rulings, and decisions since 1917. *Nowhere else* in print is anything like this available.

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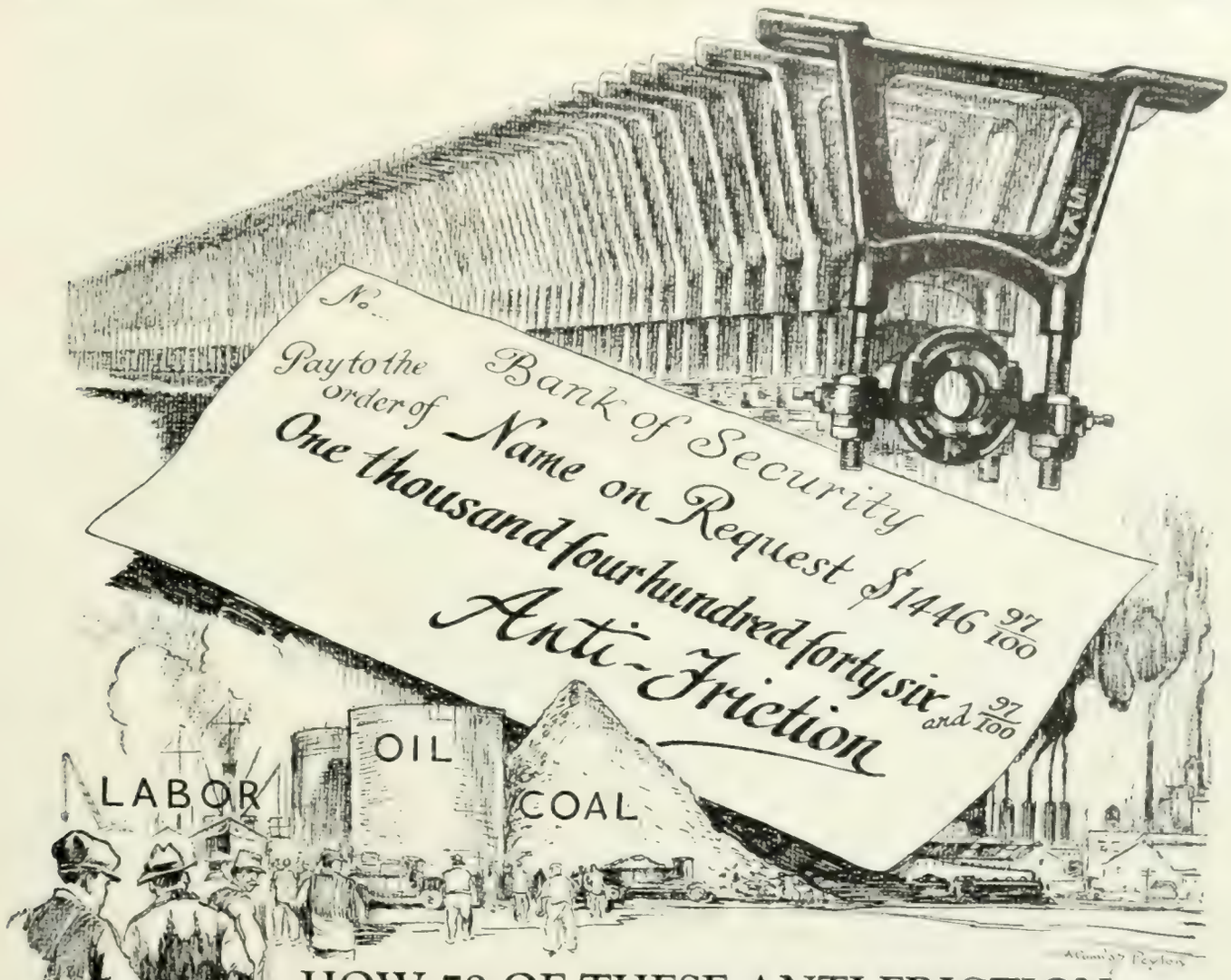


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But an idea may be gleaned from the experience of a large textile mill* that formerly used plain bearings on its line shafting. After years of general dissatisfaction, excessive maintenance and power costs, 79 Skayef Self-Aligning Ball Bearing Hangers were installed. The result was that the very first year, the cost of power and maintenance was reduced $1,446.97—93% of the cost of Skayef installation.

SKF engineers will show you how Skayef line shaft equipment will reduce your power and maintenance costs, speed up production, eliminate expensive delays and pay for itself in less than two years' time.

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The SKAYEF BALL BEARING COMPANY, 165 Broadway, New York

**BALL BEARING**

# SKAYEF HANGERS

**POST HANGERS, PILLOW BLOCKS** SKF Puts the Right Bearing in the Right Place **AND TRANSMISSION APPLIANCES**

THE AMES MANUFACTURING COMPANY
COMPARATIVE BALANCE SHEET
As of December 31

| *Assets* | 1921 | 1922 | 1923 | 1924 |
|---|---|---|---|---|
| Cash | $ 4,652 | $13,371 | $ 7,190 | $10,512 |
| Accounts Receivable—Net | 14,468 | 8,217 | 5,629 | 5,857 |
| Net Quick Assets | $19,120 | $21,588 | $12,819 | $16,369 |
| Inventories | 17,556 | 20,607 | 28,077 | 22,210 |
| Total Current Assets | $36,676 | $42,195 | $40,896 | $38,579 |
| Fixed Assets—less Depreciation | 17,922 | 25,707 | 36,163 | 37,290 |
| Prepaid Expense | 76 | 213 | 2,545 | 2,459 |
| Total Assets | $54,674 | $68,115 | $79,604 | $78,328 |
| *Liabilities and Capital* | | | | |
| Notes Payable—Trade | $ 1,000 | | $ 3,000 | $ 1,000 |
| Notes Payable—Bank | 4,000 | $ 4,000 | 3,000 | 2,000 |
| Accounts Payable | 7,000 | 4,000 | 8,000 | 5,000 |
| Dividends Payable | 2,000 | | 2,000 | 2,000 |
| Accrued Liabilities | 128 | 690 | 337 | 248 |
| Current (and Total) Liabilities | $14,128 | $ 8,690 | $16,337 | $10,248 |
| Capital Stock Outstanding | $50,000 | $50,000 | $50,000 | $50,000 |
| Surplus—Deficit | 9,454 | 9,425 | 13,267 | 18,080 |
| Total Net Worth | $40,546 | $59,425 | $63,267 | $68,080 |
| Total Liabilities and Net Worth | $54,674 | $68,115 | $79,604 | $78,328 |
| Sales | $52,088 | $66,383 | $80,052 | $96,691 |

## What Would You Read From These Figures?

From the data given at the left, would you say that the Ames Manufacturing Company is carrying too large an inventory?

Is it tying up too much money in receivables?

Is there any tendency to over-investment in fixed assets?

Do you see any serious evidence of insufficient capitalization?

Would you suggest any immediate remedial measures?

Everything considered, is the company in good position?

*Here is a new volume which gives you a definite basis for positive answers to questions like these—*

# Analyzing Financial Statements

By STEPHEN GILMAN

Certified Public Accountant; First Vice President, International Accountants' Society, Inc.; formerly member of the firm, Tanner, Gilman & Ellis; formerly Manager of Credit Department, Tennessee Coal, Iron and Railroad Company; Author of "Principles of Accounting"

A REMARKABLE manual of organized method, procedure, and technique for accountants, credit men, corporation officials, and investors. Its viewpoint is that of the man, outside or inside of the organization, who must form his judgments without access to information other than that contained in properly constructed accounting statements.

### *Give Definite, Flexible Procedure*

This volume gives you definite and unusually effective procedure for determining from both balance sheets and profit and loss statements the real trends and conditions in the companies preparing them. It suggests programs for analyzing both single and comparative statements. It shows how to use such common measures as the current and "acid test" ratios; what danger signals to watch out for; and how to determine the causes for changes favorable and unfavorable.

### *Shows How to Recognize Business Weaknesses*

It points out positively what conclusions should be drawn from the presence of any particular indication. It is the *first book* in which the methods of analysis are interlocked with the detection of specific business ailments. As gauges for these ailments, the author suggests eight ratios among such items as sales, net worth, current assets, and current liabilities. These he shows how to compare for successive statements, using for illustration a number of actual comparative balance sheets and profit and loss statements covering several years' operations. He includes also a valuable chapter on the use of "standard ratios".

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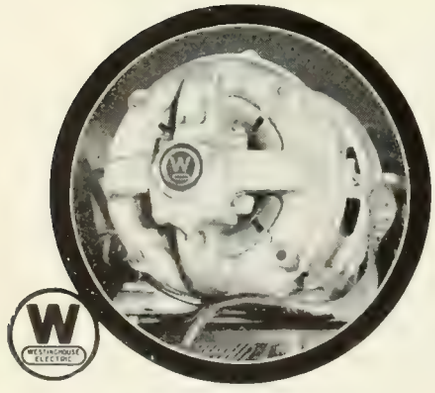

This motor is being used in severe machine tool service. When the photograph was taken it had been operating over ten months, without oiling. The oil level in the overflow plug had not lowered perceptibly.

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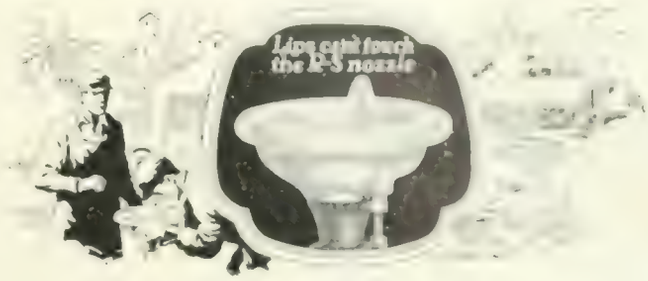
| Wallace Clark | 70 |
| Copper and Brass Research Association | 79 |
| Fafnir Bearing Company | Fourth cover |
| General Fireproofing Company | 79 |
| Gerrard Wire Tying Machines Company | 61 |
| Geuder, Paeschke & Frey | 69 |
| Heverle & Hay | 70 |
| Penrose R. Hoopes | 70 |
| Hyatt Roller Bearing Company | 2, 80 |
| Jenkins Brothers | 78 |
| Link Belt Company | 1 |
| Marion Tool Works | 78 |
| Mercury Manufacturing Company | 78 |
| Merrick Scale Manufacturing Company | 79 |
| Miller, Franklin, Bassett & Company | 70 |
| Mississippi Wire Glass Company | 76 |
| Nash Engineering Company | 4 |
| Walter N. Polakov Company | 70 |
| Powers Accounting Machine Company | 71 |
| Professional Counsel | 70 |
| Ronald Press Company | 62, 64, 68, 72 |
| Rundle-Spence Mfg. Co. | 69 |
| Scovell, Wellington & Company | 70 |
| Skayef Ball Bearing Company | 63 |
| Stevenson, Harrison & Jordan | 70 |
| Stone & Webster | 74 |
| Superheater Company | 76 |
| Taylor Instrument Company | 75 |
| Westinghouse Electric & Manufacturing Co | 65, 66, 67 |



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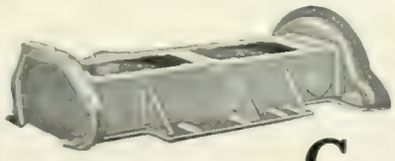

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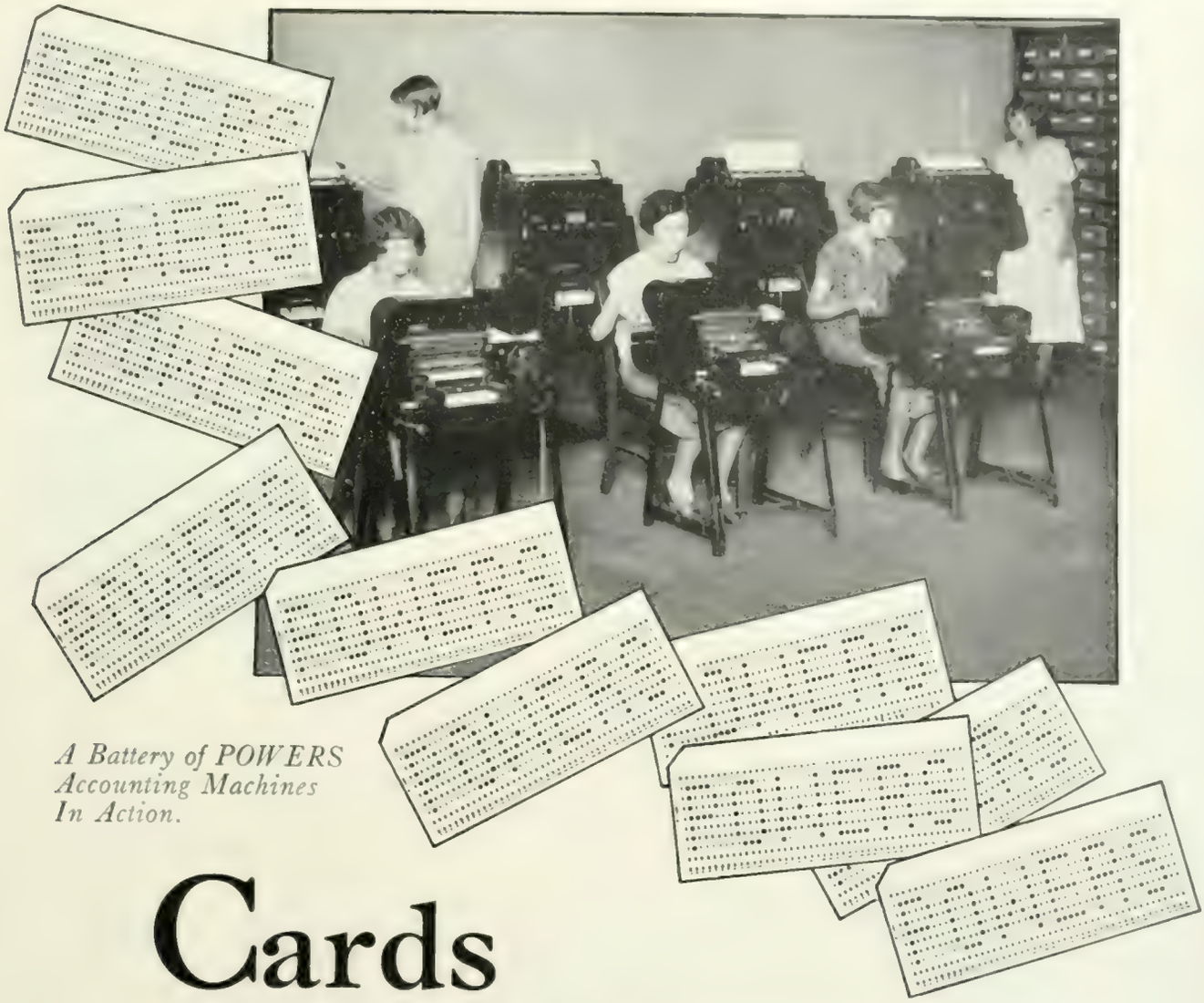

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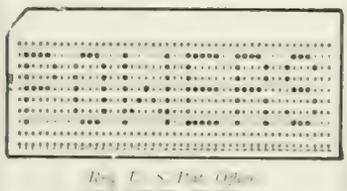

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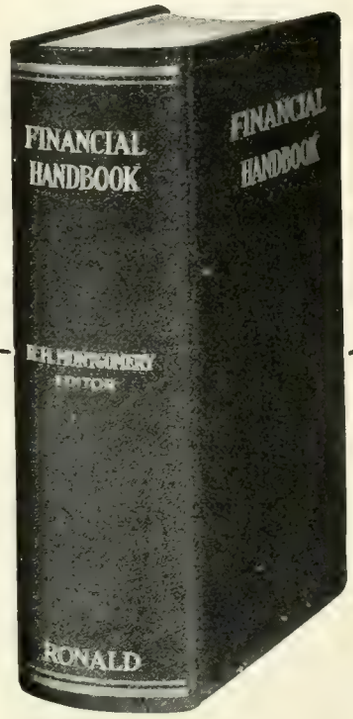


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PAGE

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Copper and Brass
Copper and Brass Research Association . . . . 79

Industrial Trucks
Marion Tool Works . . . . . 78
Mercury Manufacturing Company . . . . . 78

Instruments, Recording
Taylor Instrument Company . . . . . 75

Lineshaft Bearings
Hyatt Roller Bearing Company . . . . . 79

Scales
Merrick Scale Manufacturing Company . . . . . 79

Superheaters
Superheater Company . . . . . 76

Time Recorders
Calculagraph Company . . . . . 77

Valves
Jenkins Brothers . . . . . 78

Ventilating, Heating and Power Equipment
Buffalo Forge Company . . . . . 76

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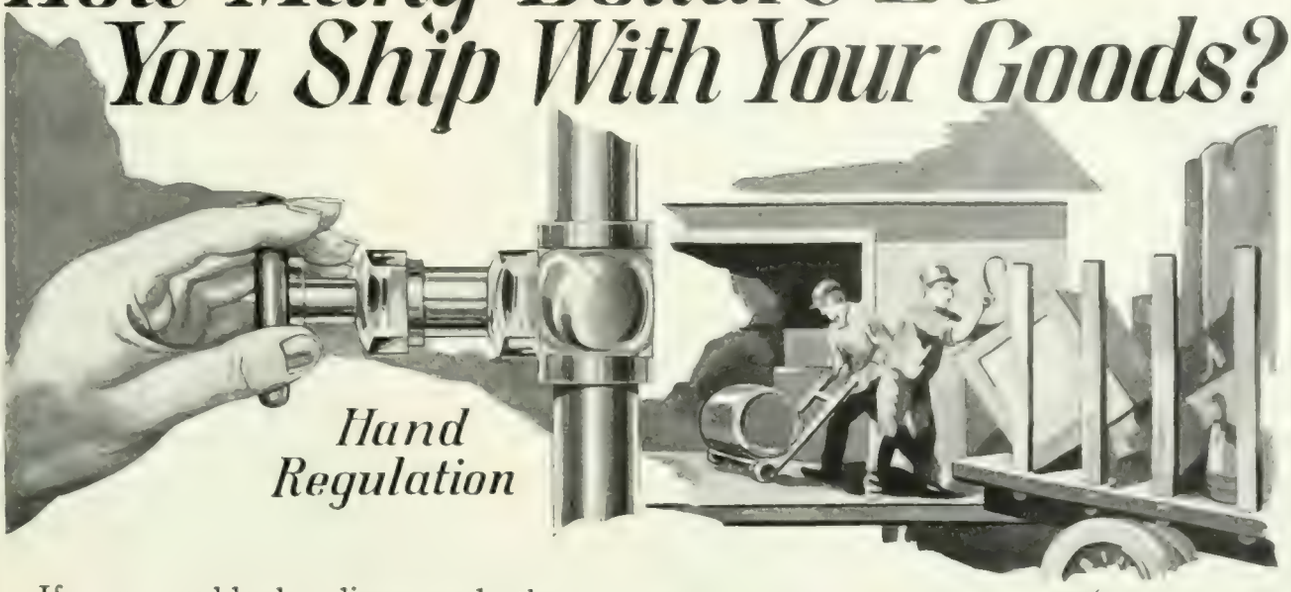


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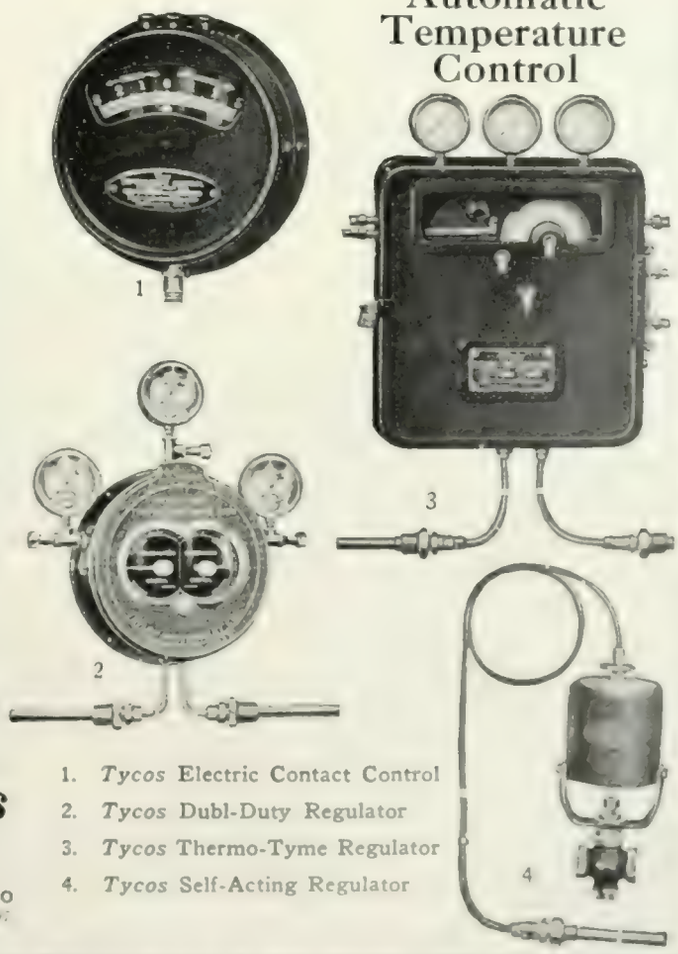


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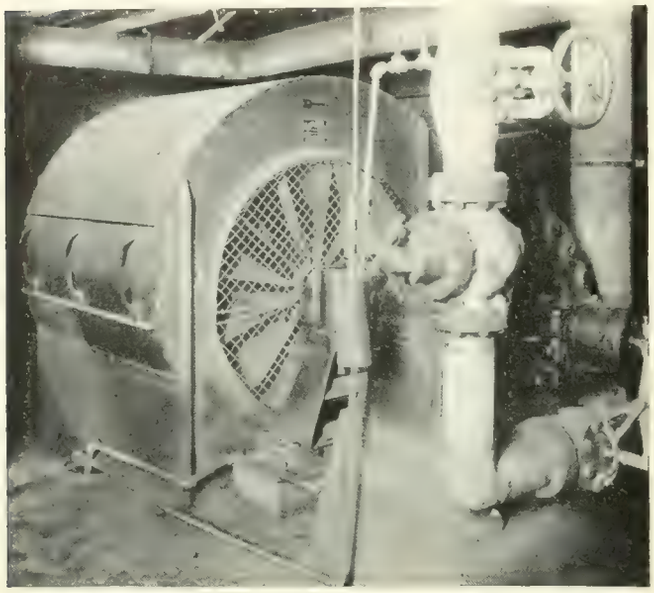

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"By the use of stokers and forced draft we are able to operate our boilers at 270% of their normal rating. As our plant works 24 hours a day all the year round, and Sundays during the winter months, we consider that our equipment is subjected to unusually heavy service. **Our Buffalo Forge fans have been very satisfactory, and have given us practically no trouble or expense for upkeep or repairs."**

Our catalog No. 730 describes these fans. Perhaps we can help you to cut costs in your plant.

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**453 Broadway, Buffalo, New York**
*Branches in All Principal Cities*

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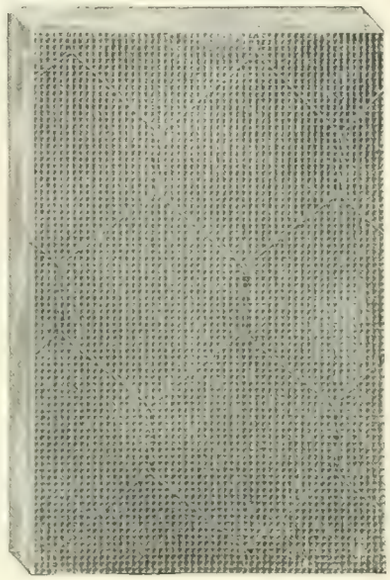
For windows, this is the best type of glass to install.

Because it is scientifically designed especially for windows to eliminate the glare of the sun and afford uniform light distribution.

By using Factrolite it is possible to increase the light in a room 25 feet or more deep from 38 to 72 per cent as compared with clear glass.



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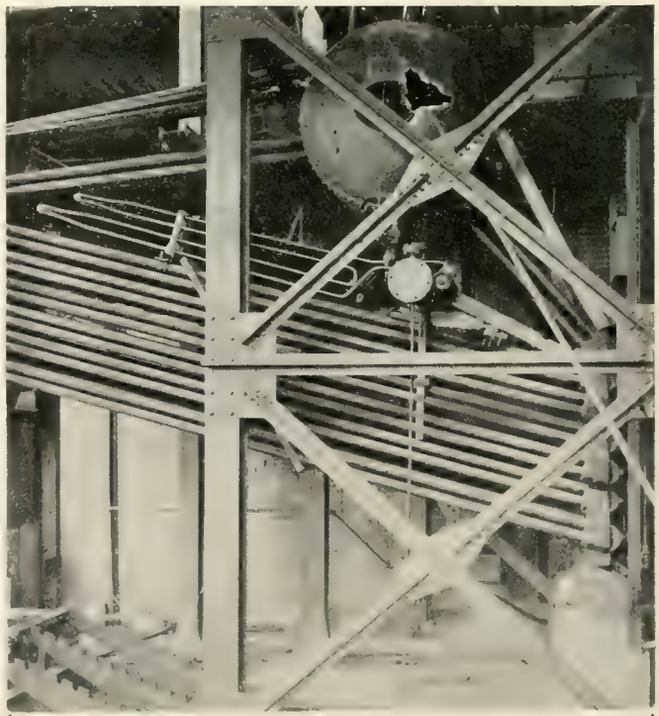

ELESCO SUPERHEATER installed in a 242 hp. Springfield boiler at Kimble Glass Co., Vineland, N. J., maintains an even superheat at 100 degrees at 150 lb. boiler pressure. Note minimum obstruction to gas flow and accessibility for installation and inspection due to the design and arrangement of the Elesco Superheater.

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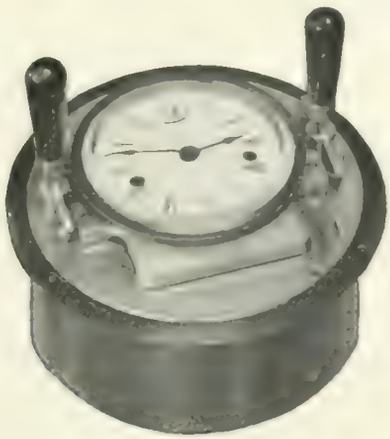

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[ This is No. 1 of a series ]

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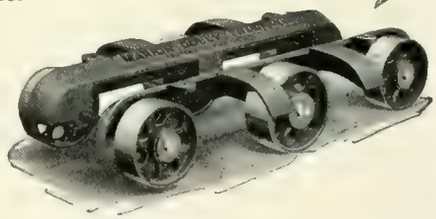

Your savings in stock and manpower will make it cheaper for you to own Marion Dollys than to try to skimp along without them. Write today for complete information prices and special 10-day trial offer.

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## as a matter of course

*Fig. 106, screwed Jenkins Standard Bronze Globe Valve.*

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TYPICAL INSTALLATION

*Material being handled over Weightometers*

COAL
ORES all kinds
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CLINKER
ROCK
GYPSUM
FISH
FERTILIZER
PHOSPHATES
SAND
PAPER MILL PRODUCTS
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## what price upkeep—

Repairs, replacements and the annoyance that goes with them are not wholly inevitable.

For instance, where metal enters into construction—COPPER, BRASS and BRONZE, appropriately used, reduce or entirely eliminate the expense caused by repair or renewal of rusted parts.

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Welded construction throughout, beautifully and richly finished in baked-on enamel, *Allsteel* Files—like the entire *Allsteel* Office Equipment line—guarantee you *permanent* satisfaction, at a reasonable cost.

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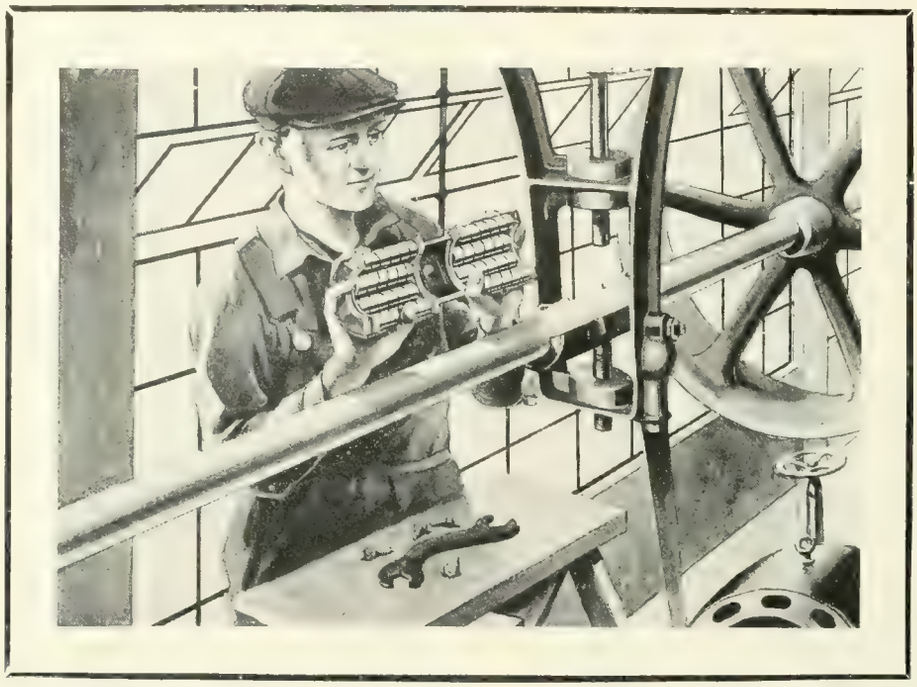

# Easy to install because it's *split*

THE *new* Hyatt lineshaft roller bearing is split, as its predecessors have been for 35 years.

Therefore, it is not necessary to dismantle the entire transmission line when installing. Pulleys, clutches and other shaft fittings are not disturbed, nor is it necessary to move hangers.

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It takes but seven minutes to remove an old bearing and install the *new* Hyatt. A small wrench is the only tool used.

Just lay the lower half of the box on the shaft and roll it under to its operating position. Tighten the adjusting bolt. Drop the top into place, turn down four bolts which seal the two halves, and then turn down the upper adjusting bolt in the hanger. Lubricate, align and turn on the power.

A small quantity of oil three or four times a year assures efficient operation of all Hyatt bearings. Machined housing joints prevent oil leakage.

Friction is eliminated where Hyatt roller bearings are used, because they impart an easy rolling motion.

Once installed, Hyatt line shaft bearings last a lifetime.

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*'Phone your nearest mill supply dealer*

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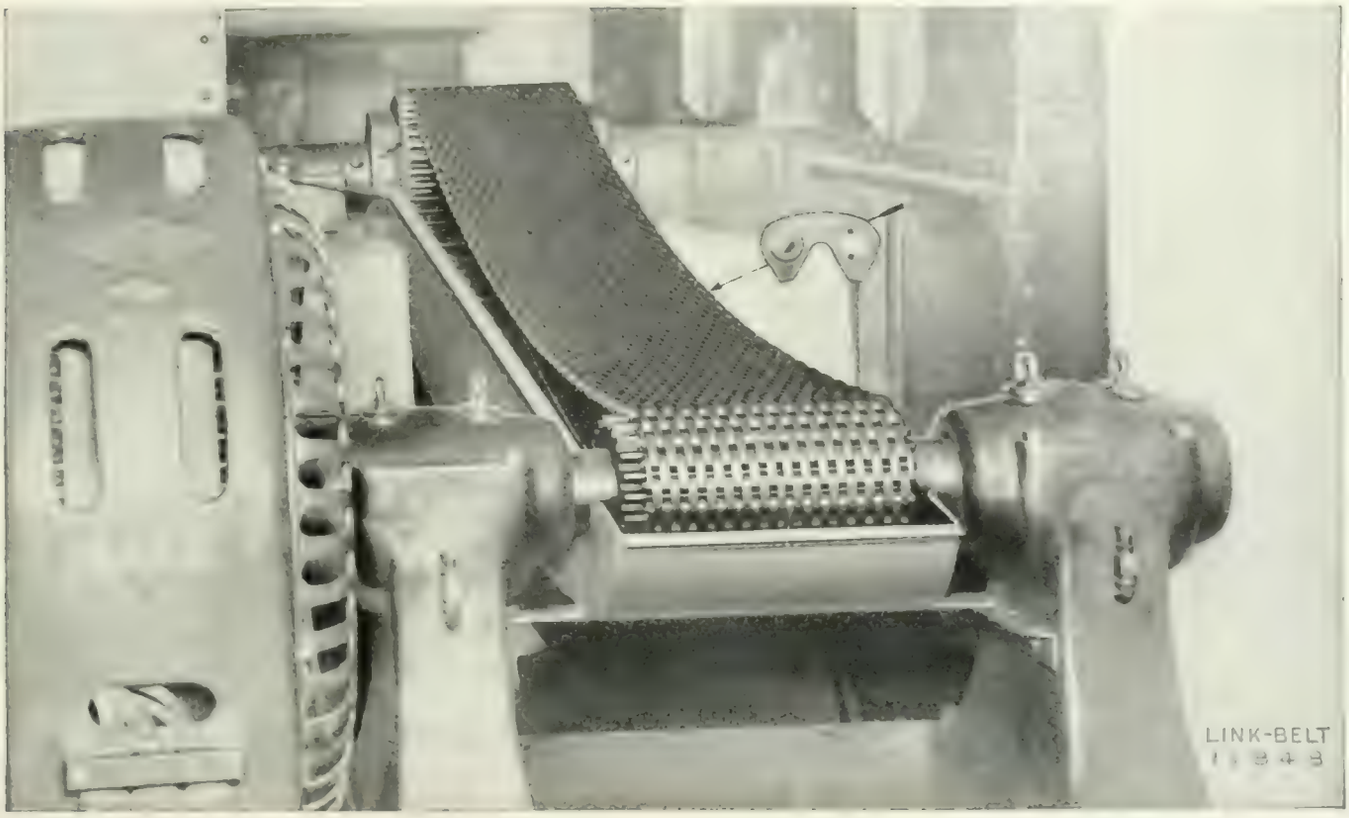
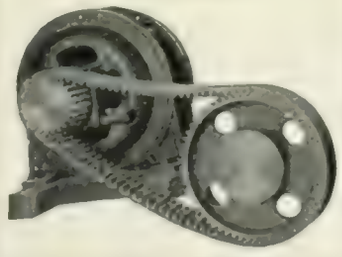
**ROLLER BEARINGS**

# "Running for Twelve Years and We Haven't Spent a Nickel on Them—"




**Drives Now Carried in Stock**

Link-Belt Silent Chain Drives, from ½ to 10 H P., in almost any speed ratio from 1 to 1 up to 7 to 1, can now be obtained from stock from a Link-Belt Distributor near you. Send for Book 725, or name of your nearest distributor.



SAID a certain veneerman to a Link-Belt engineer. Quoting further from his statement—"Yes, our drives will wear out, but built as Link-Belt builds them, Silent Chains are dependable".

Then he showed our engineer several machines which had not lost an hour's time in 12 years where failure could be attributed to power transmission.

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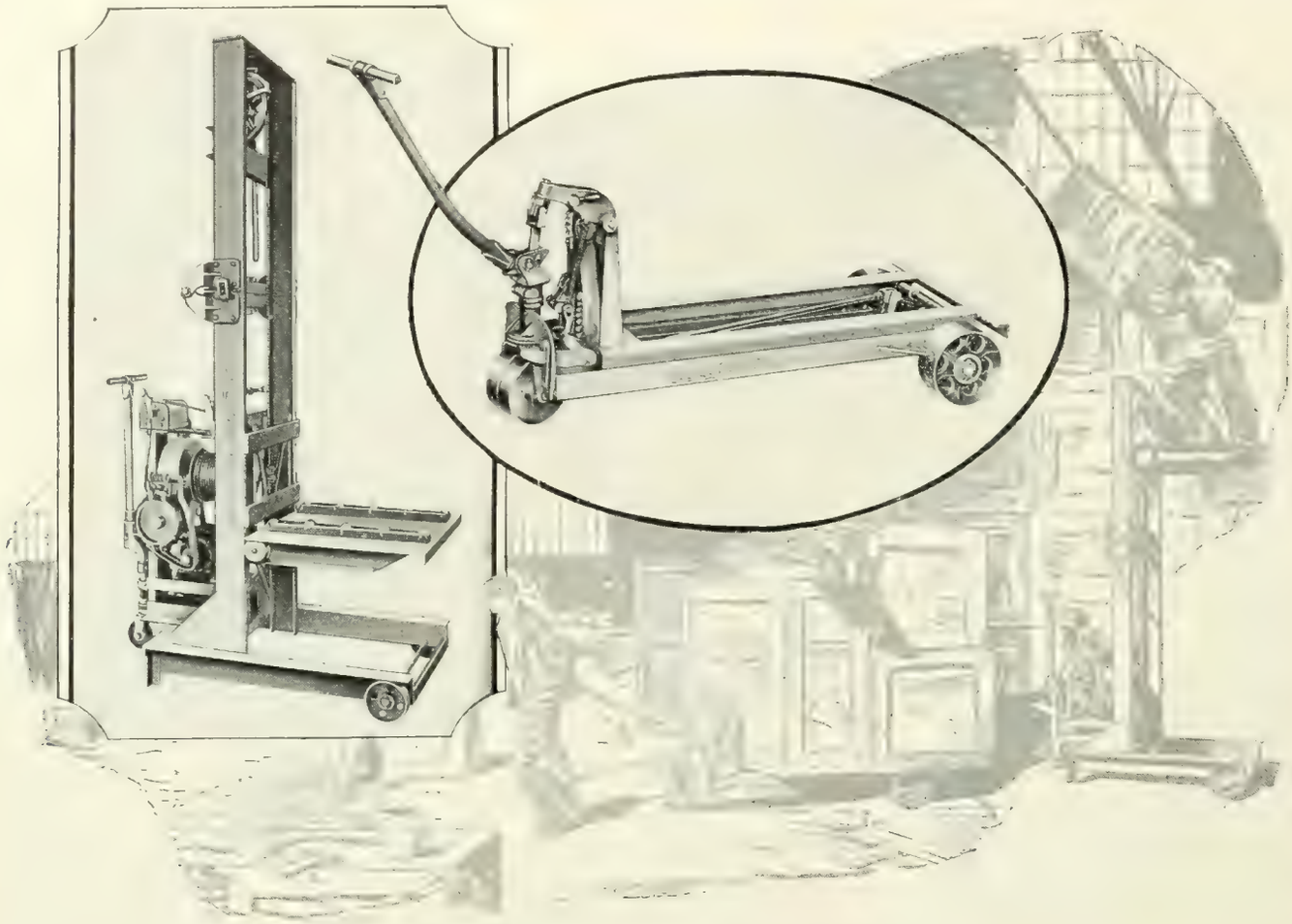
# LINK-BELT

## Efficient Silent Chain Drives



# Putting the Power of a Pachyderm in the Hands of One Trucker

THE Worm Drive Electric Stacker—and the Jack-Lift truck with two front wheels—new developments of the Lewis Shepard Company of Boston, Mass.—are of course Hyatt equipped.

Users and manufacturers alike know that one man and a Hyatt equipped truck or stacker easily handles heavy, bulky materials that formerly staggered several men.

Adoption of Hyatt Roller Bearings means positively lubricated rolling motion substituted in place of the rubbing, sticking action of ordinary bearings. They take the strain off your truckers reduce floor wear—and lengthen the life of equipment.

And besides increasing the capacity of your trucking system and storage space—they reduce maintenance worries and expense.

Lubrication every three or four months is the only attention that this Hyatt equipment requires. This means time and money saved when low production cost depends upon a continuous flow.

Lewis Shepard Company and the several other manufacturers of such high class equipment specify Hyatt Roller Bearings because they know that they add to the value of their products.

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WORCESTER PHILADELPHIA CHARLOTTE
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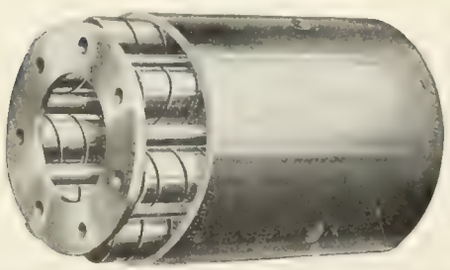

HYATT
ROLLER BEARINGS

MANUFACTURING INDUSTRIES—*Vol. XI, No. 2—Published on the first of each month by The Ronald Press Company. Subscription price $5.00 per year. Publication office, Federal and Nineteenth Streets, Camden, New Jersey. Entered as second-class matter in the post office at Camden, New Jersey, under the Act of March 3, 1879.* *Copyright 1926 by The Ronald Press Company.*

MANAGEMENT AND ADMINISTRATION IN

# MANUFACTURING INDUSTRIES

L. P. Alford, *Editor* George E. Hagemann, *Associate Editor*

Vol. XI CONTENTS FOR FEBRUARY, 1926 No. 2

| | | PAGE |
|---|---|---|
| Buick Saves $3,500,000 in Nine Months | W. W. Clark, Jr. | 85 |
| Successful Budget Installation | Carey E. Tharp | 89 |
| Simplified Production and Handling | H. H. Edge | 93 |
| Unfair Selling Prices | W. L. Churchill | 97 |
| Scientific Planning for the New Western Electric Plant | O. C. Spurling | 101 |
| Coal and Ash Handling at Quarter the Cost | | 106 |
| Offsets for High Manufacturing Costs | Thomas D. Perry | 107 |
| Reducing Lumber Handling Costs | | 111 |
| Judging Organization and Personnel | Arthur Andersen | 113 |
| Accounting for Values or Dollars | Joseph F. Dillman | 118 |
| Cutting Labor Costs 37 Per Cent | Charles N. Underwood | 119 |
| Special Truck Cuts Handling Time in Half | | 124 |
| Finding Causes of Quality Variations | W. A. Shewhart | 125 |
| Speculators or Machine Builders | | 128 |
| Saving Money on Shipping Containers | | 129 |
| Guide to Latest Information | | 131 |
| News of Manufacturing Industries | | 136 |

Rutledge Bermingham, *Advertising Manager* L. G. Henderson, *Circulation Manager*

Published monthly by THE RONALD PRESS COMPANY, [illegible]. All Correspondence with the publishers should be addressed to [illegible]. If Change of Address [illegible] cannot be sure to receive [illegible] take to supply missing issues from files [illegible] each.

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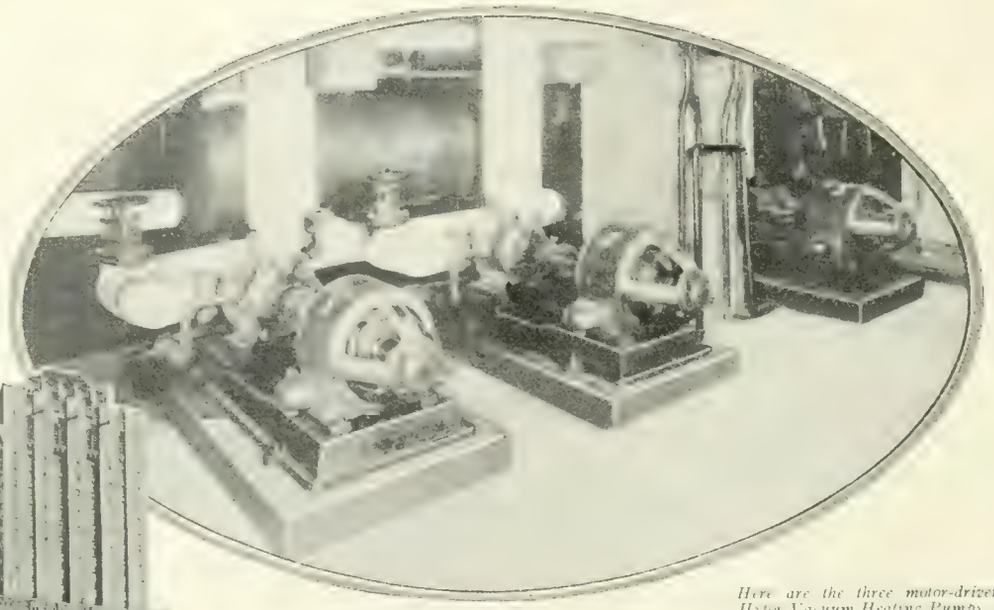
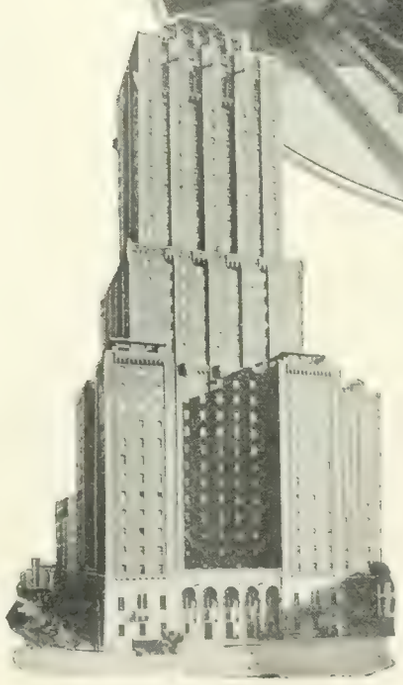


*Here are the three motor-driven Jennings Hytor Vacuum Heating Pumps, installed on the return line heating system of the Shelton Hotel, New York, N. Y.*



*Shelton Hotel, Lexington Ave. and 49th St., New York, N. Y. Mr. Arthur Loomis Harmon, Architect; Jaros and Baum, Consulting Engineers; Gillis and Geohegan, Heating Contractors; Shelton Holding Corpn., Owners.*

# Hytors serve the Shelton, also

Three motor-driven Jennings Hytor Vacuum Pumps are depended on for removing the condensation and air from the return line heating system of the Shelton Hotel, New York, N. Y.—two units each capable of handling 65,000 sq. ft. equivalent direct radiation, and a third suitable for 40,000 sq. ft.

In a building of this character, good heating is a requisite of first importance. Only the most efficient design, and equipment will assure the results that are expected and demanded,—and the fact that Hytors were specified for this installation is a significant recognition of their excellence.

Jennings Hytors deserve this commendation. In the many years they have been in use, they have conclusively proved again and again that they give reliable service season after season, with the characteristic dependability that distinguishes superior equipment.

NASH ENGINEERING COMPANY

So. Norwalk Connecticut

*Write for these Bulletins. They completely describe the several Jennings Heating Pumps,—their construction, method of operation and the superior service they always give in the uses for which they are recommended.*

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**Jennings Hytor**

RETURN LINE AND AIR LINE VACUUM PUMPS CONDENSATION AND CIRCULATING PUMPS

MANAGEMENT AND ADMINISTRATION IN
MANUFACTURING INDUSTRIES

VOLUME XI FEBRUARY, 1926 NUMBER 2

# Buick Saves $3,500,000 in Nine Months

## Intensive Study of Labor, Materials and Scrap Has Remarkable Results

By W. W. CLARK, Jr.

*Factory Economist, Office of H. H. Bassett, President, Buick Motor Company*

THE Buick Motor Company is running at its capacity of over a thousand cars a day, with 5000 less employees than in 1923 when production reached the figure of 925 cars per day. It has also effected economies in manufacturing which in themselves seem trivial, but which become items of great importance when the entire saving is estimated. The result is that the company is turning out its product of the same high quality as at any previous time, but at a greatly reduced cost to the consumer.

### Up-to-Date Equipment and Methods

The reduction of working force has been brought about through the installation of up-to-date equipment as soon as it is developed, and by numerous changes in machines and in methods of handling stock, materials and scrap.

Various manufacturing economies have been accomplished in the face of an ever changing situation. First, the comparatively small output in 1924 mounted upward in 1925 to the largest in the history of the company. Then, the production of closed cars in 1923 of approximately 38 per cent of the total, today is over 88 per cent of all models built.

This latter condition necessitated a radical revamping in every phase of body building, painting and trimming. The small production of 1924 intensified the drive for economies along even broader lines than those regularly employed before. This campaign, as in the past, was based on a scientific study of every detail of operating costs in each unit of the entire works. In accomplishing this end, it was necessary:

First, to utilize to the fullest extent the experience in factory operation and cost distribution of the executive heading the work, and the training and experience of his assistants.

Second, in each unit to make a study of all the various items of expense over an extended period of time, in order to get the correct picture of its operations under various conditions.

Third, to make a careful study of plant operations and personnel for as long a time as necessary to obtain a fair idea of current operations and to confirm deductions made from analysis of the expense.

Fourth, to make a written report to the works manager covering all phases of the investigation, including favorable comments, as well as criticisms and suggestions.

Fifth, where necessary, to hold a meeting of the works manager, general superintendent and unit executives for discussion and instruction.

This plan has been largely responsible for the splendid showing made, and it is accomplishing its ends without the necessity of any radical changes in the management of the different plants. It has given the superintendents an opportunity to become better posted on expense distributions. They are better able to analyze them, to put their fingers on any items of excessive cost and to enlarge upon or tighten down methods already used in controlling their expenses.

Manufacturing expenses can usually be divided into:

1. Fixed and non-controllable expenses such as:
   Taxes
   Insurance
   Depreciation

FIG. 1 GENERAL VIEW OF BUICK MOTOR COMPANY'S MODERN

2. Variable or controllable expenses such as:
   Non-productive labor
   Operating supplies
   Tools
   Maintenance and replacement
   Scrap

An increase in the fixed expenses as a result of additions to plant buildings, machinery and equipment normally results in a much greater reduction in variable expense. This comes about in two ways: If the expenditure is for additional machinery, or for more floor space, or both, there follows greater production, which means reduced cost. If the expenditure is for special tools, or special equipment, such as conveyors, there follows a reduction in labor with its corresponding saving.

### SAVINGS MADE THROUGH TWO CHANNELS

The Buick Motor Company has made savings through both channels, as for instance: The stamping plant prior to July 1923 was a one-story building with a roof of saw-tooth construction. While this building was nearly 1150 ft. long and 150 ft. wide, the increased production called for more floor space and height. A modern two-story building was designed to replace the old one. This was erected around and over the old building without losing a day's production, or even a single automobile. It was erected by Buick's engineers and construction crew at a cost of 15 per cent less than estimated. The results obtained from this building with its larger capacity, modern equipment and better working conditions have made the increase in fixed charges well worth while.

Aside from the increased capacity and production, with resultant lower cost, a saving worthy of note has been made in scrap losses. They have been so greatly reduced that the average cost for scrap in eight months of 1925 shows a saving of over $120,000 compared with the average cost during the last half of 1924. This has been accomplished by furnishing additional floor space, by better methods of handling work in process, and through the work of a steel expert who is at all times in co-operation with the superintendent and in close touch with the steel mills, seeing to the delivery of steel of the proper gauge, finish and treatment. Also, by a careful study of the actual raw material requirements of stampings, the company has been able in many instances to change specifications as to finish, treatment, pickling, etc., thereby saving very substantially in the original cost of productive materials.

Labor-saving devices are continually being installed, such as mechanical and gravity conveyors. These conveyors may range from a simple arrangement on which to slide work from operation to operation, to one for handling automobile bodies from the third floor of the body plant, down to the basement, under a street through a tunnel 200 ft. long, then up to the first floor of the paint department. This installation made a big saving by eliminating the use of trucks and men for handling. The company has been able to wash sheet metal stampings automatically, and is now drying them mechanically, doing away with many men, and saving much expense in wiping rags, etc.

Special machines have been installed in some departments, enabling the operators in some cases to double their daily output. In many instances new methods have been developed which eliminate productive costs and expenses at the same time.

Controllable items of expense have also been reduced to bring about substantial economies. The ratio of productive labor to the total labor employed depends entirely upon the nature of the product and the amount of mechanical equipment used in manufacturing and handling it. Some time ago standards were set for each factory covering the number of men per foreman, or the number of productive men per inspector, based on past performance. As soon as

AUTOMOBILE MANUFACTURING PLANT AT FLINT, MICHIGAN

the superintendent reached or bettered that ratio, it was lowered, until finally it was felt that the ratio was as low as it could be consistent with economical and satisfactory production. The superintendents, in turn, set limits for all classes of non-productive labor in each department and saw that foremen adhered to this schedule. The results were apparent when in the face of a reduction of 5000 men in the working force, the ratio of productive labor to total jumped six points to the highest percentage in the history of the company.

Extensive tests are run on practically all standard mill supplies and perishable small tools. A graphic chart showing tests on belting is shown in Fig. 2. As high as one hundred tests on belting are run at one time. When the purchasing department obtains an especially attractive price, tests are run to determine if this material is as good or better than that in use. Standards are set upon each and closely adhered to. Superintendents receive daily statements showing all expense materials used in their respective plants. These statements show the kind and quantity of material used, its cost, and the department to which it is charged. The superintendent passes these on to the department foremen and, where advisable, takes up these expense items with the foremen, singly or in a general meeting.

Certain hard and fast rules are laid down regarding the distribution of expense material. For instance, a laborer cannot obtain a new shovel without returning his old one to the stock room. A machine operator cannot obtain a new drill without returning the old one. All small standard tools go to the tool salvage department to be repaired for further use on the same job or on some other work.

The few examples in Table 1, selected at random from hundreds, show the result in the cost per car. They illustrate the enormous saving which can be made in large production through a large number of such economies, when all are added together and taken from the cost of each automobile produced.

Items of expense in maintenance and replacement are vitally necessary to the economical operation of a plant, for it is in this department that "a stitch in time saves nine." The general maintenance department has functioned so well that a shut-down of any plant or department because of power trouble or breakdowns is practically nil, even in the face of a reduction of nearly 300 men in this department from the number employed in 1923.

TABLE 1. COSTS OF TYPICAL ITEMS PER AUTOMOBILE PRODUCED, AS LOWERED BY IMPROVED METHODS

| ITEM | PERIOD | | |
|---|---|---|---|
| | 1923 | 1924 | 8 MONTHS 1925 |
| Belting | $0.67 | $0.52 | $0.399 |
| Abrasive cloths and sandpaper | 0.26 | 0.24 | 0.197 |
| Aprons, gloves and mittens | 0.07 | 0.047 | 0.046 |
| Files | 0.275 | 0.199 | 0.110 |
| Hack and band saws | 0.027 | 0.026 | 0.021 |

Maintenance repairs and alterations are being made continually in individual plants in the form of permanent improvements representing savings which cannot be estimated. For instance, in the grey iron foundry, the molten metal is all handled with overhead monorail cranes. Until about two years ago, one or more of these cranes was always down for repairs. A wholesale job of rebuilding and strengthening them was done, and today it is most unusual to find one out of commission for more than a few minutes. Thus a big saving in maintenance, and a greater saving in loss of production through delay, have been effected.

In the forge shop, preheating furnaces have been designed by the management of this plant to replace

old furnaces. The new furnaces are so designed as to fit each particular job, to better localize and retain the heat, to save fire brick, to speed up the work and to better the job for the furnace men. These furnaces are being built by department men and installed as fast as completed. Less than one-third of the furnaces have been replaced and these have been of the

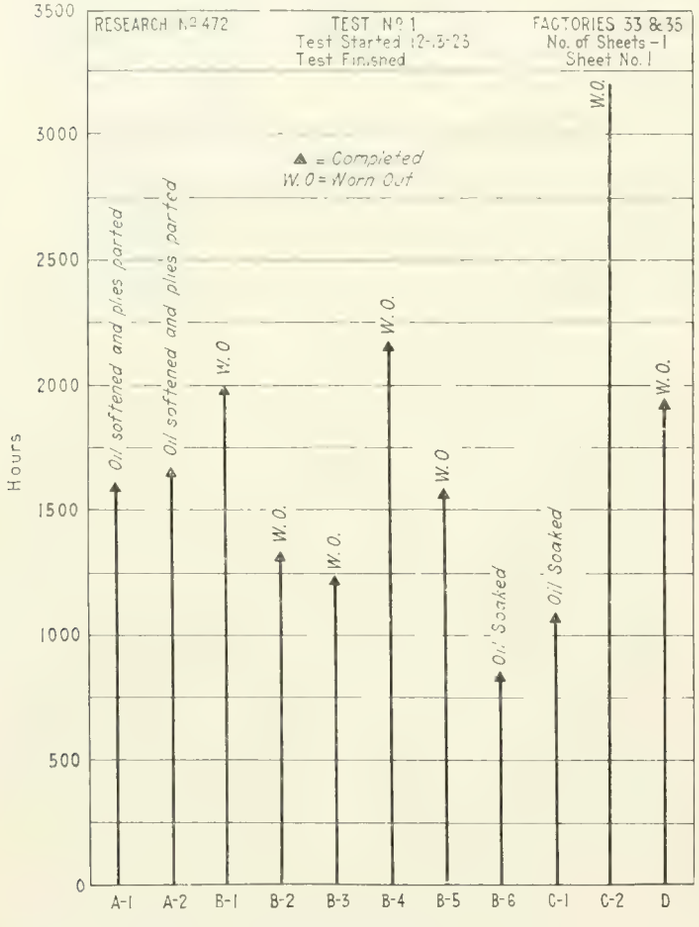



FIG. 2 TEST MADE BY EFFICIENCY DEPARTMENT ON 2½ IN. WIDE BELT ON GARVIN TAPER SPINDLE DRIVE

Symbols A-1, A-2, etc., refer to different kinds of belting.

smaller type, yet the saving in fuel oil alone to date has been great. The cost of oil per ton of good forgings in October 1924 was $0.25 less than in October 1923. In August 1925 it was $0.75 per ton less than in October 1923. This expenditure, while making a great saving in maintenance labor and material, has also made a big saving in an operating supply item.

Savings made in scrap losses in the sheet metal plant have already been mentioned. Inasmuch as scrap is the worst evil of any manufacturing expense, and far-reaching in its contingent costs, the Buick Motor Company is constantly working to reduce this item.

In each of the manufacturing units, the superintendents go over the scrap personally every day, not in the office but right on the job. The factory accounting department furnishes each superintendent with a daily report of the scrap, item by item, divided as to departments and showing the loss in dollars and cents. An accumulative record is kept by the superintendent showing the scrap per unit which he manufactures, and similar departmental records are kept for the foreman so that his entire staff may tell at all times how each is running. The average scrap loss per car has been cut more than 50 per cent since 1923 and is improving all the time.

This improvement has been accomplished through the purchase of the best materials and tools, through the use of the most efficient machinery, through a reduction of labor turnover, and through education and instruction, which means better supervision and foremanship.

Losses due to shut-downs from lack of material, whether it be one machine or an entire plant, are practically eliminated. The material, purchase, follow-up, stock and production departments have so perfected their systems of inventory control that manufacturing schedules are well met not only as to raw materials but also in inter-factory movements from raw to finished cars. The amount of productive material necessary at all times to "float" each plant, and the length of time required for each part to progress from raw to finish, have been thoroughly worked out to the end that there is no doubt as to when or for how much material a release shall be given to meet certain schedules. These departments now run with fewer men, due to consolidation and simplifying the work.

As far as possible, the stock department stores finished materials in unit containers. This eliminates all counting except when the container is originally filled. It simplifies and cheapens checking, inventory, and delivery to assembly lines.

The production department handles inter-factory movement of material in the same way. For instance, the final inspector in the forge shop loads a unit container with 100 front axle I-beams. This rack or container is moved by tractor to the machine shop of the axle division where it goes from operation to operation until the forgings reach the first assembly point.

Also, some material is received from outside sources in special racks or containers furnished by the Buick Company, on which the material remains until delivered to the primary operations. These features have resulted in a great reduction in handling and men.

Much work has been done to eliminate wasteful use of water, leaky steam pipes and air lines, loss in power transmission, and unnecessary use of electric lights, either by removal or re-location. For instance, the work in connection with lights was started about July 1924 and the saving per car in the first seven months of 1925, compared with the same period in 1924, was $0.28.

Original productive labor, non-productive labor, expense of materials and scrap, are the four big items going to make up the cost of operating the plant, over which the factory has control. The average cost per car of these four items has steadily decreased each year, and is reflected in the reduced prices of Buick cars. The total saving for the first nine months of 1925 was $3,500,000. It pays to watch the little things.

# Successful Budget Installation

## Performance and Results in the Textile Industry

By CAREY E. THARP

THE 1924 budget operations described in the previous issue,[1] accomplished the following results:

1. Introduction of the expense budget into every department of the company.
2. Preliminary education of the staff on budget requirements and procedure.
3. Securing a general attitude of co-operation toward budget policies.

The last two items are of vital necessity during the initial stages of any budget. It does not matter which phase of the budget field is developed first, so long as the principal initial aims are co-operation and education of staff. The next logical steps were:

1. To complete the scope of the expense budget.
2. To crystallize and organize routine, rulings and procedure.
3. To extend the scope of the budget to other fields.
4. To develop standards, by which to establish estimates and measure performance.

Analysis of the nature of expenses indicated that no advantage could be gained by extending the expense budget to the following items:

1. Salaries of chief executives.
2. Insurance, taxes and depreciation.
3. Direct manufacturing payroll.

The first item is not available, since it is confidential and cannot be isolated even as a total for all chief executives. Moreover, it is not controllable by any executive, but by the Board of Directors. The second item, also, is not controllable by any executive, as it is either the result of general policies of the treasurer and the Board of Directors, or else it is fixed by outsiders, as in the case of taxes. The third item, direct manufacturing payroll, is almost entirely piecework, and fluctuates directly with the volume of production.

The completed expense budget, as initiated in 1925, included the following items:

I. Head Office Expense
   1. Accounting and finance department.
   2. Selling and advertising.
   3. Salaries (except chief executives).
   4. General office expense.

II. Mill Expense.
   1. Non-manufacturing departments (Subdivided by units).
      A. Maintenance of equipment.
      B. Salaries.
      C. General expense.
   2. Manufacturing expenses (By mills)[2]
      A. Mechanical labor.
      B. Machine supplies.
      C. Room supplies.
      D. Indirect labor.
      E. Salaries.
      F. General expense.

In order to establish a workable budget estimate on manufacturing operations, it is necessary to make some assumption in regard to the future volume of production, for this is the fundamental variable that affects most operating expenses. Costs of operation may vary directly in proportion to the volume of production, as for example, direct payroll, or they may be entirely independent of production, as in the case of most head office expenses. Usually, however, manufacturing expenses come in between these extremes; they are affected by changes in the rate of production, but not in direct proportion thereto.

The value of budget estimates depends primarily on their fairness as a standard of performance. This is affected by two factors:

1. Accuracy of production forecast.
2. Application of this forecast to expense estimates.

One does not expect the resultant estimate to be absolutely accurate, for a computation of each of the above factors is subject to an element of error. But production forecasts within 10 per cent of accuracy are readily possible in the textile industry.

The following discussion is an outline of the organization in our company as applied to production estimates, and to the method of using production estimates, after having determined them.

The Selling Department estimates future sales, based on the trend of past sales, and the Budget Department makes an independent forecast, by way of a check. The Selling Department is held responsible for the accuracy of the final sales forecast, however, and unless figures presented by them are unreasonable,

[1] MANUFACTURING INDUSTRIES, January 1926, pp. 29-34.

[2] Items A to D inclusive were subdivided by manufacturing departments, but items E and F were given in total for each mill.

the Budget Department does not insist on revisions. Our methods, however, are far more comprehensive than theirs, and involve considerably more statistical technique than would be possible for them to use. We therefore expect to persuade them by means of facts and reasoning to revise their estimates, if their figures indicate that revisions should be made.

The Budget Department ascertains from the treasurer the probable future inventory policy, and converts forecasts of the volume of sales into estimates of the volume of production. Estimated production of each class of goods is divided between mills by the agent, whenever the same class of product is manufactured in two or more mills; for responsibility for distributing the total production among the various mills lies entirely with this executive. He uses as a basis the actual division of production by mills during the years immediately preceding.

The Budget Department takes no further action on production estimates, beyond that mentioned above. Distribution of production forecasts is like playing with dynamite, since it can easily cause labor trouble, and the agent, who is responsible for the labor situation, should have a free hand with which to handle the gunpowder. The main likelihood of trouble comes whenever production forecasts indicate a busy future; labor, if cognisant of this fact, would probably demand better terms, and might actually cause trouble. The agent's policy is very successful here, and no trouble has ever occurred. He distributes production figures to his head executives, only, and impresses upon them the fact that such figures are strictly confidential.

Thus, at every stage, the Budget Department has focused responsibility upon some other branch of the organization. The Selling Department is responsible for sales forecasts, and the treasurer provides an inventory policy. This gives automatically the production forecast. The agent distributes production by mills, and diffuses to his subordinates all information pertaining to production estimates. In each case, the Budget Department supplies the necessary data, makes independent checks and suggests changes; but in no case is the Budget Department responsible for performance of these functions.

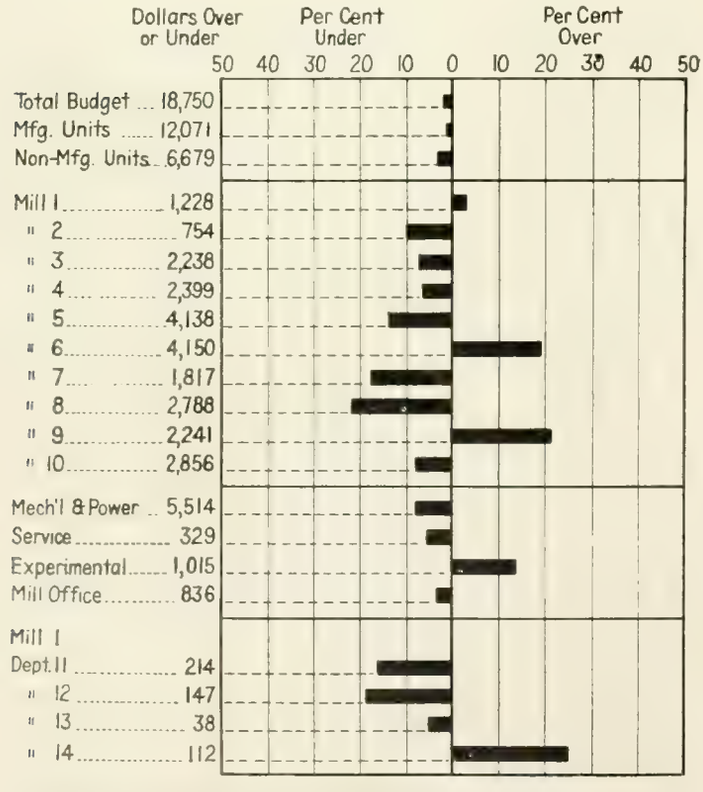

Dollars Over or Under
Per Cent Under
Per Cent Over
50 40 30 20 10 0 10 20 30 40 50
Total Budget ... 18,750
Mfg. Units ..... 12,071
Non-Mfg. Units.. 6,679
Mill 1 ..... 1,228
" 2 ..... 754
" 3 ..... 2,238
" 4 ..... 2,399
" 5 ..... 4,138
" 6 ..... 4,150
" 7 ..... 1,817
" 8 ..... 2,788
" 9 ..... 2,241
" 10 ..... 2,856
Mech'l & Power .. 5,514
Service ..... 329
Experimental ..... 1,015
Mill Office ..... 836
Mill 1
Dept. 11 ..... 214
" 12 ..... 147
" 13 ..... 38
" 14 ..... 112

FIG. 5 CUMULATIVE BUDGET PERFORMANCE—AUGUST 1925

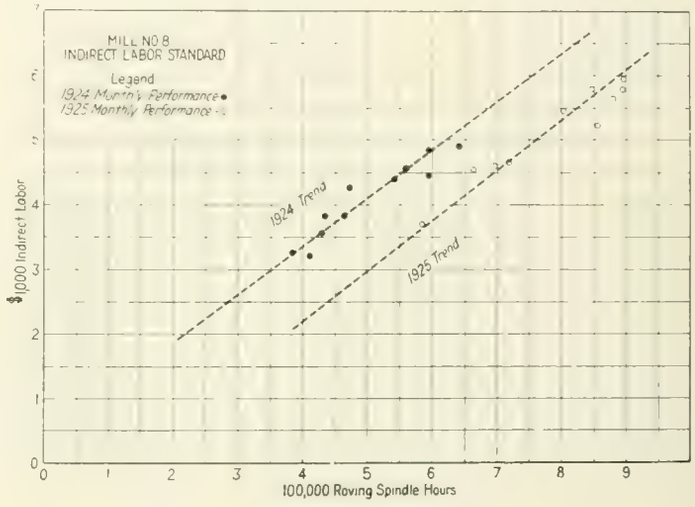


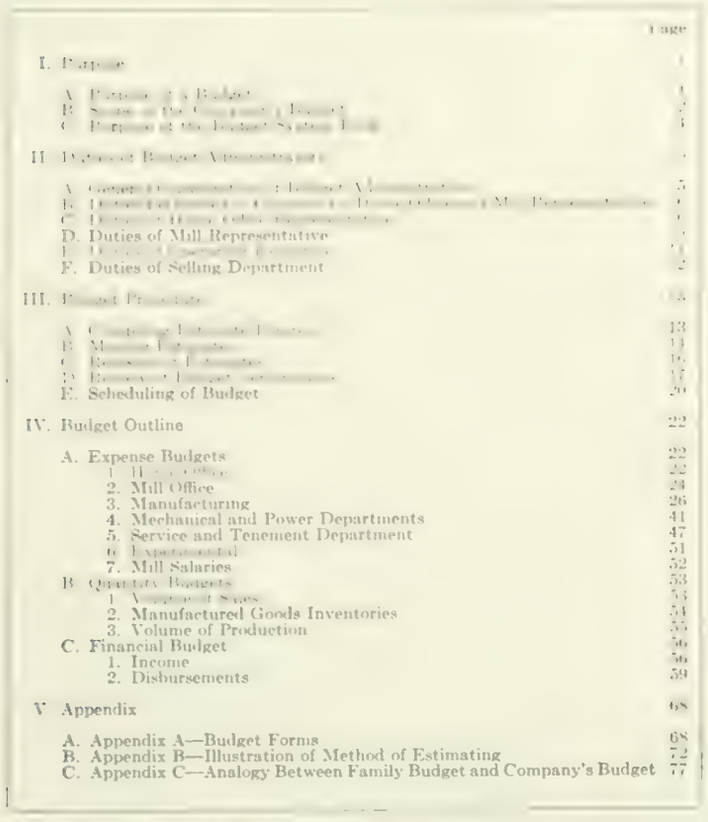

FIG. 6 INDIRECT LABOR STANDARD

After having determined the expected volume of production for the new budget period, it is necessary to show the operating executives how to use the information. The mill superintendent will ask, "Suppose I know that the expected volume of production in my mill is 30 per cent larger than the actual production for 1924, how much will that increase my expenses?" In order to use production estimates to much advantage, it is obvious that some means be created of measuring the amount of expense that should correspond with any given rate of production. To overcome this, we have set up standards for each class of expense. In manufacturing departments, this would mean standards for (1) mechanical labor, (2) machine supplies, (3) room supplies, and (4) indirect labor. These, in turn, would have to be subdivided, so as to show separate standards for each mill, and each department.

Fig. 6[3] illustrates a simple way of setting up expense standards, at a minimum clerical cost. It represents the indirect labor expense that should accompany any given volume of production for No. 8 Mill. The vertical scale shows the indirect labor payroll, and the horizontal, roving spindle hours. The time element is ignored, except to differentiate between years: solid dots represent 1924 monthly performance, and circular dots, that for 1925. The dotted lines show the visual trend of monthly performance for each year.

Each year's trend is distinct, although the amount

[3] Preceding figures are in the January article.




Page

I. Purpose 1

A. Purpose of a Budget 1
B. Scope of the Company's Budget 2
C. Purpose of the Budget System Book 3

II. Organization 4

A. Company Organization; Budget Administration 5
B. Duties of Budget Director and Budget Department 6
C. Duties of Home Office Executives 7
D. Duties of Mill Representative 7
E. Duties of Engineering Department 8
F. Duties of Selling Department 9

III. Budget Procedure 13

A. Controlling Executive's Duties 13
B. Manager's Duties 14
C. Executive's Duties 16
D. Executive's Budget Conference 17
E. Scheduling of Budget 20

IV. Budget Outline 22

A. Expense Budgets 22
1. Home Office 23
2. Mill Office 24
3. Manufacturing 26
4. Mechanical and Power Departments 41
5. Service and Tenement Department 47
6. Experimental 51
7. Mill Salaries 52
B. Quantity Budgets 53
1. Unfilled Sales 53
2. Manufactured Goods Inventories 54
3. Volume of Production 55
C. Financial Budget 56
1. Income 56
2. Disbursements 59

V. Appendix 68

A. Appendix A—Budget Forms 68
B. Appendix B—Illustration of Method of Estimating 72
C. Appendix C—Analogy Between Family Budget and Company's Budget 77


FIG. 7. TABLE OF CONTENTS OF BUDGET SYSTEM BOOK

of indirect labor per spindle hour is different for the two years. The substantially lower indirect labor cost per machine hour in 1925 over the previous year is undoubtedly due mainly to budgetary control, since the budget was extended to indirect manufacturing labor on January 1, 1925. The trend for both years is so definite, however, that we can decide within narrow limits the amount of indirect labor necessary to produce a given number of roving spindle hours.

The 1926 standard will be the 1925 performance. Suppose the 1926 production forecast represents 9,600,000 roving spindle hours, when the original forecast in terms of pounds or yards is converted into machine hours. An average monthly share would be 800,000 spindle hours; and according to our standard the indirect labor (see chart) should be $4,250 per month, or $51,000 per year. This provides a simple, rapid check, that has reasonable accuracy, and necessitates a minimum of work with previous records.

We send each mill superintendent a copy of the standard that applies to his mill, covering, of course, all expenses for which he is budgeted. He can divide the budget among his departments in any way that he sees fit, but he knows that his total budget for all departments must not be incompatible with a reasonable standard as shown by this chart.

The Table of Contents of our Budget System Book is shown in Fig. 7. Chapter I is mainly introductory. It gives a bird's-eye view of the functions that might be served by a budget, of the principal aims of this company's budget, and of the function of the budget system book.

Chapter II shows the division among executives of the various duties that must be exercised by someone in any budget organization. This includes both the executives who administer the budget, and those who operate under it, gives the exact authority and responsibility of each, and how they are related to each other. This chapter cannot be written with much success until the budget has attained sufficient growth to justify a rather definite organization. It is really a crystallization of the ideas that began developing early in our budget experience. We quoted partially preliminary exposition of these ideas in the previous paper.

Chapter III gives the "paper work" of the budget, i.e., the methods followed in estimating, and in reviewing performance. This shows the exact procedure that is followed by both the Budget Department and the operating executive in regard to all estimates and reports. It includes the "Scheduling" of the budget, or the dates on which all estimates and periodic reports are due. This is especially important in case of estimates, for they are usually somewhat late due to the fact that they have to go through the hands of several executives, and a definite schedule speeds them up considerably.

Chapter IV gives a complete list of subdivisions into which the budget is divided. It defines each, explains the accounting source of the figures, and shows methods of proving them against accounting records. This completes the main organization of our system book; but we have added appendices containing appropriate illustrations of budget philosophy, that should be useful for reference.

A financial budget differs from an income statement mainly in that it *forecasts* income and disbursements over some *future* period of time, whereas an income statement records as a matter of history what *has hap-*

| | | | |
|---|---|---|---|
| Estimated Receipts | | | |
| Sales of product A | $ 420,000 | $ [illegible] | $ 600,000 |
| " " " B | 135,000 | [illegible] | 95,000 |
| " " " C | 40,000 | [illegible] | 60,000 |
| " " " D | [illegible] | [illegible] | 125,000 |
| " " " E | [illegible] | [illegible] | 70,000 |
| Total Sales | $ [illegible] | $ [illegible] | $ [illegible] |
| Sales of foreign exchange | [illegible] | [illegible] | [illegible] |
| Surplus cash over $250,000 | [illegible] | [illegible] | [illegible] |
| Investments | [illegible] | [illegible] | 710,000 |
| Total liquid funds | $ [illegible] | $ [illegible] | $ [illegible] |
| Estimated Disbursements | | | |
| Notes payable | $ [illegible] | $ [illegible] | $ [illegible] |
| Payroll | [illegible] | [illegible] | [illegible] |
| Factory overhead | [illegible] | [illegible] | [illegible] |
| Interest | [illegible] | [illegible] | 10,000 |
| Taxes | [illegible] | [illegible] | 15,000 |
| Raw materials | [illegible] | [illegible] | 200,000 |
| Machinery | [illegible] | [illegible] | [illegible] |
| Power | [illegible] | [illegible] | [illegible] |
| Dividends | [illegible] | [illegible] | [illegible] |
| Miscellaneous | [illegible] | [illegible] | 30,000 |
| Capital expenditures | [illegible] | [illegible] | 10,000 |
| [illegible] | $ [illegible] | $ [illegible] | $ [illegible] |
| [illegible] | $ 965,000 | $ [illegible] | $1,110,000 |

[illegible] CASH DISBURSEMENTS SHEETING FINANCIAL BUDGET—1925

[illegible] [illegible] [illegible] [illegible] [illegible] the estimated valuations at the beginning of the month; "Surplus or Shortage" represents the estimated amount at the end of the month, and all other items show the estimated performance during the month.

*pened* over some *past* period of time. In form they may be almost identical.

### Application of the Financial Budget

Many concerns have a financial budget and do not recognize it as such. My company has operated under one for years, calling it a Cash Position Sheet (see Fig. 8). When we were extending the scope of our budget, so as to include all functions of control we did not change this statement at all, for it fulfills every requirement that could be covered under any other form of financial budget. This illustrates the principle that we have tried to follow consistently, of never making up a budget for the sake of having a budget. If any phase of a budget does not fill some existing need, for purposes of administrative control, then that particular phase has become useless red-tape.

A strong concern uses the financial budget as a means of utilizing its working capital to better advantage. If the concern should require $30,000 per week to meet all of its cash requirements, it is not economical to keep $300,000 on deposit, for some of this money might be earning interest. On the other hand, $75,000 would be inadequate, unless there were securities that could be liquidated to advantage overnight. If a concern is forced to meet an unexpected emergency by hasty borrowing, it is likely to pay slightly high interest rates.

A weak concern requires a financial program from necessity. Having limited credit, it must make use of what cash it can acquire, if it expects to remain in business.

The work of laying out a financial program is comparatively simple, as compared with an expense budget. There is no large amount of clerical routine, no executives to educate, no goodwill to secure. This budget is the special tool of the comptroller, and the rest of the organization do not necessarily know of its existence.

### Cash Position Sheet

Our Cash Position Sheet covers semi-annual periods, and estimates income and disbursements for the end of each month covered by this period. Estimated liquid balances are carried forward to the following month, affecting the cash position of that month.

We have observed two rules in making this sheet: first, that we desire substantial accuracy of estimates two months in advance, but for subsequent months a cash position is mainly useful for showing general trends of liquid assets. Consequently, it is unnecessary to spend a great deal of time forecasting income several months in advance, provided we feel that estimates for immediate months are fairly accurate. Second, we tend to slightly underestimate income, and overestimate disbursements. Any given item of either income or disbursements cannot be forecasted exactly, of course, and this method provides additional protection against financial embarrassment.

The first section of Fig. 8 shows the cash that we estimate we should receive from sales. The October cash to be received from sales of Product A is $420,000, and is, roughly, the value of sales of this product during September. We add to the estimated total sales the estimated cash on hand October 1 (over a safety balance of $250,000) and the amount of investments in bonds and other securities. This gives the total amount ($1,625,000) that we estimate can be used for disbursements during October without borrowing. Estimated disbursements of $660,000 leave an estimated surplus of $965,000.

The difference between $965,000 and the value of securities ($625,000) is $340,000 which is the estimated cash on hand for the November position, provided holdings of securities do not change. In this case, $100,000 of securities matured, and the cash increased to $440,000 for November.

### Estimated Performance Revised from Actual

When actual performance for a month is available, the estimated performance for all subsequent months is revised, to take care of the adjustment. Suppose October's actual surplus were only $865,000 due to the purchase of more raw material than was anticipated, the estimated cash balance for November and December would be adjusted to $340,000 and $80,000, respectively. Surpluses at the end of these months would also be reduced by $100,000 each.

Suppose it were obvious later in the season that November cash receipts from sales would be much less than the figure of $1,000,000 anticipated earlier, and detailed analysis indicated $800,000 as a fairer figure. The "liquid funds" of $1,965,000 would be cut by $200,000, and the surplus (last line) would be cut by the same amount. This would reduce the estimated cash balance for all subsequent months by the same amount.

Suppose it became known that only $200,000 instead of $700,000 would be spent during November on raw material. This would increase the estimated cash balance for December 1 from $180,000 to $680,000 (above a "safety margin" of $250,000.) Obviously this would be too much unemployed capital, and the concern should invest the greater part of it in securities during November.

In theory, this budget is identical with an expense budget. The mechanics only, by which they are utilized, is different. Both the Cash Position Sheet and the Expense Budget establish standards of performance, based upon past experience, and study actual results in light of these standards. The expense budget usually maintains its standards irrespective of variations of actual performance therefrom; standards are not revised from month to month, but actual results are being constantly measured by this yard-stick. The financial budget establishes monthly progressive standards of expected performance over several future months, and revises subsequent figures whenever actual performance in a previous month replaces the estimated performance.

# Simplified Production and Handling

## Methods of Kelly Press Based on Classification of Work in Round and Flat Groups

By H. H. EDGE

*Works Manager, Kelly Press Division, American Type Founders Company, Elizabeth, New Jersey*

UNDER the title of "The Modern Manufacturing Plant," an article by John F. Fallon, Assistant Manager of the Kelly Press Division, American Type Founders Company, appeared in a previous issue of MANUFACTURING INDUSTRIES.[1] This article was a comprehensive description of the general construction facts of the new factory at Elmora Station, Elizabeth, New Jersey, a short distance out from New York City on the main line of the Central Railroad of New Jersey.

The plant was designed and built for the production of the company's well-known line of automatic printing presses, invented by William M. Kelly, who is general manager of the company. This factory is the largest in the world devoted exclusively to the production of automatic printing presses. It is also the most recently built plant for this purpose.

FIG. 1 ROUGH STORES—ROUND WORK

For these various reasons it is felt that a full explanation of its production and equipment features will be of interest, particularly as the operating system and plan of tool equipment arrangement have resulted in appreciable savings in handling of material and in speeding up production.

In any manufactured product there are some elements of design, material, machinery and sales that are identical, or in common, with other products, but every article that is fabricated or manufactured also has certain elements or problems that are individual. In the picking out of these unique phases, and in the determination of how far methods, machinery or appliances used by others can be exactly employed in the particular case, or how far and how much originality or pioneering in new ways and equipment can or must be employed, is one measure of the ability of management and the engineer. "Cure for one is poison for another," is true in manufacture as well as in medicine.

It is equally true that, in general, certain results, or certain production symptoms, indicate to every practical engineer certain time-honored correctives. A hot bearing indicates excessive friction and suggests lubrication, but mere additional lubrication will be only a partial or temporary corrective if the details or elements of a proper bearing are not present in the particular bearing. Likewise the actual factors that are essential to cause the particular bearing to work properly are not the same as those for one to carry twice the load, at double the speed.

In other words, once again we have the truth of the old adage, "Every tub must stand on its own bottom," and equally every manufactured product requires individual study to meet its own problems in the permanently best manner.

[1] See the September 1925 issue, pp. 119-24.

Today, manufacturing methods may be subdivided into two broad classifications:

1. Quantity, or Processing
2. Individual, Separate, or Jobbing.

Of course, there is overlapping, or a twilight classification, running between the two. It is impossible to make a positive black and white demarcation in all cases, especially in the iron and steel industry.

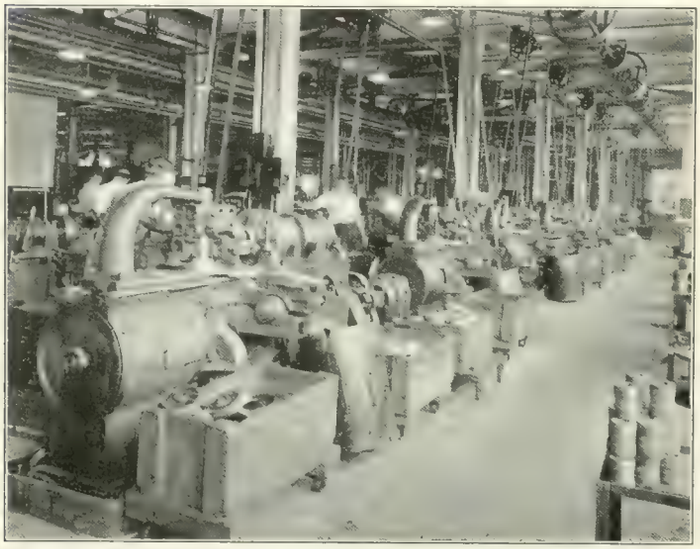


FIG. 2 TURRET CHUCKING LATHE DEPARTMENT—ROUND WORK

By quantity, or processing, is meant such products as screws, bolts, stampings, Ford automobiles, or any product completely standardized, and called for in such large quantities as to permit special machinery and long or continuous runs. In such manufacture the entire plant becomes, as it were, a single machine. Its departments are like levers or gears, and as in a machine, such departments are placed and function in full co-ordination. They must articulate in harmony, each having an equal importance in the production chain with all other links. A stoppage of one member dams the flow, and clogs or stops the entire machine.

The second basic classification—Individual or Jobbing manufacture—for extreme purposes, might be illustrated by ship-building, architectural stone carving, the building of special racing cars, locomotives, printing presses, or any heavy special machinery. Here standardization, in the foregoing meaning, is only partially possible. The use of conveyors and means for causing continuous flow are not available, or at least can be used to a far lesser extent, yet the question of routing and planning to eliminate, or reduce to a minimum, the handling and criss-cross, back flow, or stagnation of material becomes most important.

### PLACING OF MACHINE TOOL EQUIPMENT

In the former method the machine tool equipment, in number and arrangement, is decided and placed entirely according to a predetermined method or process of manufacture, with the idea of flowing the parts continuously from machine to machine, without interruption, or accumulation between.

In the latter plan the tool equipment is segregated in departments, all drills in one place, all lathes in another, and so on. In this segregated or jobbing shop plan, the work, which is constantly varying as to shape and size, is carried to the grouped tools and set up on one of the many machines.

Where productive machine tools and equipment are segregated completely, frequently the same piece will be returned several times to a department, say, drilling department, for a succession of holes, each move requiring a considerable haul and much handling, with consequent increase in the volume and value of material on the floor, and slowness in turning out the finished article. Investigation of delays in completion of the product will often show that although the plant has ample tool equipment and a large number of trucks, there are often none available to move important parts, which therefore have to be set aside and work stopped until a truck can be released, or robbed from somewhere.

In other words, an excessive amount of process material may be on trucks being toted about the plant to get to remote department for some simple operation. Perhaps it is an operation requiring a small drill press

FIG. 3 HAND SCREW MACHINES ON BAR WORK—ROUND WORK

or milling machine, that could have been done in a few minutes without any trucking by a different placing of machine tools.

### TWO TYPICAL EXAMPLES

To demonstrate in a concrete way the importance of the foregoing, the following illustrations will be of interest.

Consider the various operations in their order in the case of a larger piece—a printing press cylinder. The production of this part in an average segregated or jobbing type of shop of three floors necessitates a

large amount of travel. By a thorough study, the actual routing of the same piece in the Kelly plant, in which the machine tool equipment is arranged to constitute what we have termed a "specialty shop," or perhaps better a compromise between a true jobbing and a complete specialty layout, has been vastly simplified.

In the first instance, the cylinder is assumed to

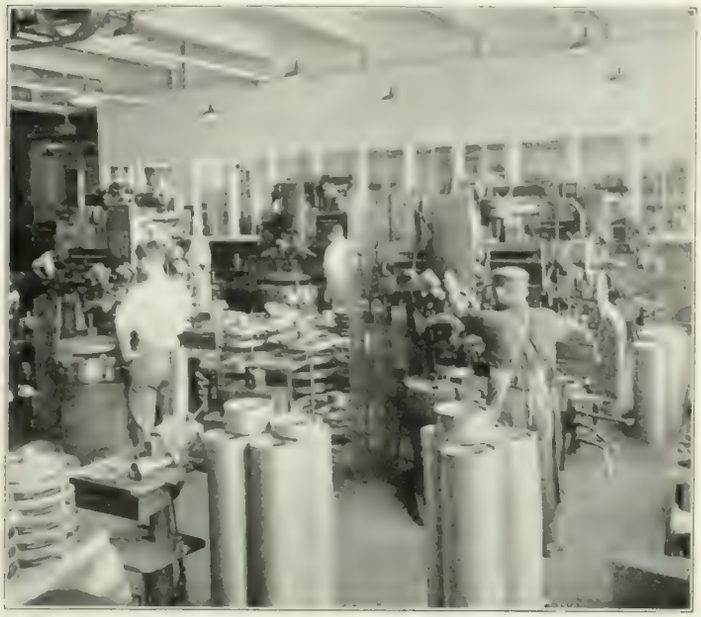


FIG. 4 VERTICAL TURRET LATHE DEPARTMENT—ROUND WORK

move from receiving stores to rough stores, both on the ground floor (one floor below railway tracks). It is then trucked to an elevator and taken to the second floor for cleaning and painting. The next move is to the elevator and down to the lathe group for three operations. Next it is trucked to the elevator and taken up to the drilling department on the second floor, then down to the first floor for grinding, then up to the second floor for milling, drilling and milling again. Thereafter it becomes a steady passenger up

FIG. 5 GEAR HOBBERS—ROUND WORK

and down elevators from operation to operation.

According to this plan, before the cylinder is completely ready for finished stores, it has been moved over 8000 ft. on trucks, or over a mile and a half. It also has to make 15 one-floor elevator trips, or more than equivalent to raising it 19 floors in one trip.

This particular piece weighs about 300 lbs., is 36 in. long and about 14 in. in diameter in unfinished condition, so not over one to three can be loaded on a truck at a time.

Now compare this with the actual conditions in the production of this part in the Kelly plant. The gross truck-feet is 2463, and the elevator handling three one-floor lifts—a reduction to less than one-third in trucking and one-fifth in elevator lifting.

To illustrate further, and selecting a lighter piece, let us follow the production of a cam. With the jobbing shop plan and method, the piece would travel over 2700 ft. on a truck and require five one-floor elevator lifts. Under the Kelly system, the same piece with identical operations is trucked only 963 ft., and calls for only one one-floor elevator lift. Again the showing is about one-third truck travel and one-fifth elevator lift, as against similar work in a strictly jobbing shop layout. This same ratio of saving would not follow with all parts, and it is also true that with very small parts, of which several thousand can be carried at a time, the saving is not so large as in the case of heavy, bulky parts. However, the foregoing analysis demonstrates the general argument, and clearly shows how, in the case of a particular plant, with its product fairly well standardized and the machine tool equipment carefully arranged, a very great saving in time, labor and cost has resulted from an intelligent study of the layout, routing and handling problems.

The good results accomplished suggest the importance, in all cases, of making a careful study or survey of any manufacturing plant to determine whether specialty shop methods cannot be applied or extended.

As explained in the previous article referred to in the beginning of this discussion, the bulk of the production equipment of the Kelly plant is distributed throughout two floors, each 165 ft. by 840 ft. in size. In laying out the equipment, and starting with the foregoing basic idea, the writer made a careful study of all machining operations entering into the company's product—automatic printing presses.

It was found desirable to classify such work under two broad divisions—"round work" such as turning, boring, screw cutting, cylindrical grinding, cam milling, etc., and "flat work" such as planing, general milling and surface or flat grinding. "Assemblying" might be termed a third class, but this is mostly bench work, although some drilling is required at assembly. Drilling machines for this purpose are provided in the subassembly department.

The criterion was whether the major portion of the work was round or flat. Many pieces involved both types of machine operation, but even so, with

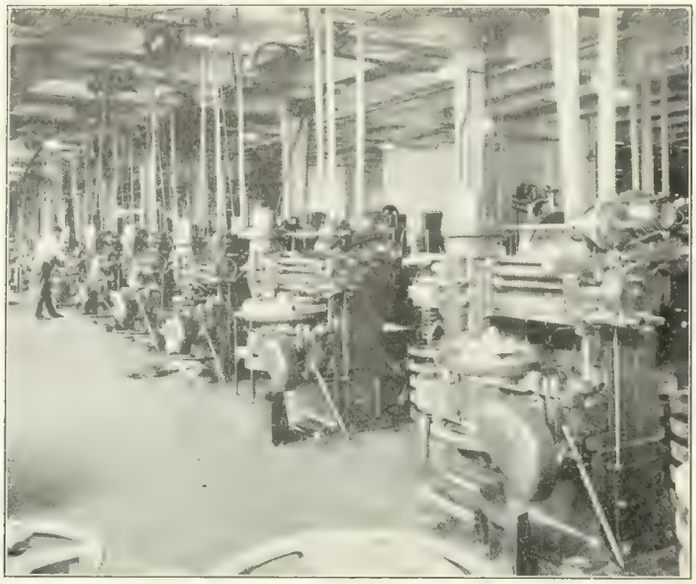


FIG. 6 FELLOWS GEAR SHAPERS—ROUND WORK

every piece it was fairly easy to determine its basic classification.

### ALL WORK "ROUND" OR "FLAT"

Therefore, all machining work was given a primary classification as either "round" or "flat." The first floor was set aside for round work, and the second floor, or receiving level, for flat work, and the tool equipment was arranged to correspond with this general plan.

Likewise, the various operations on the component parts of the products were examined, and the respective

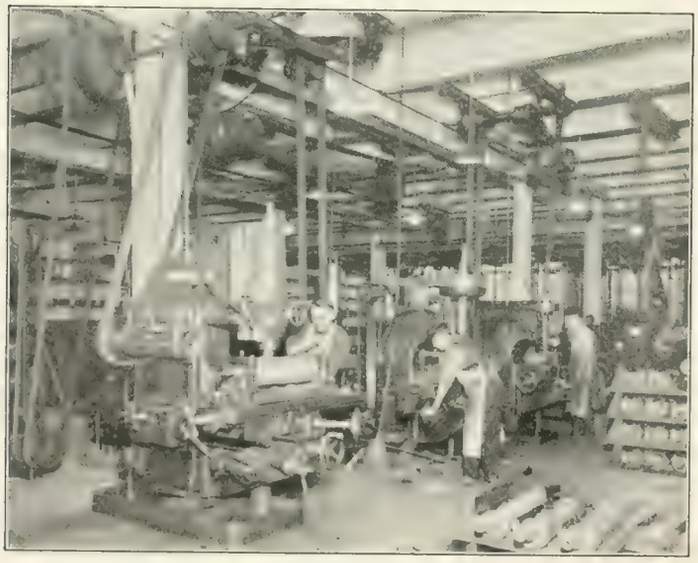


FIG. 7 LOCAL MACHINE TOOLS FOR SPECIAL JOBS ON ROUND WORK BETWEEN VARIOUS MAJOR OPERATIONS ON CYLINDERS

machine tools grouped *in general* so that parts, especially the larger and heavier ones, moved from one machine to an adjacent tool without any necessity for trucking. In this way the bulk of the heavy planers, slab millers, shapers, etc., were grouped.

However, where some single or simple drilling, shaping, or milling operation was necessary in advance of another flat operation, a suitable machine tool (or tools) for this particular operation was conveniently placed, and the operation performed there without the necessity of conveying the part away to a remote department and back. In general these intermediate special operations are simple and short, so there is no hold up of the larger machines.

When all flat, and the above described special operations are completed, the parts requiring round work are then transported to the round work department on the lower floor, where turning, and circular grinding operations are performed.

In like manner, parts primarily classed as round work are delivered in the beginning to the round work department, on the first floor, and they proceed in

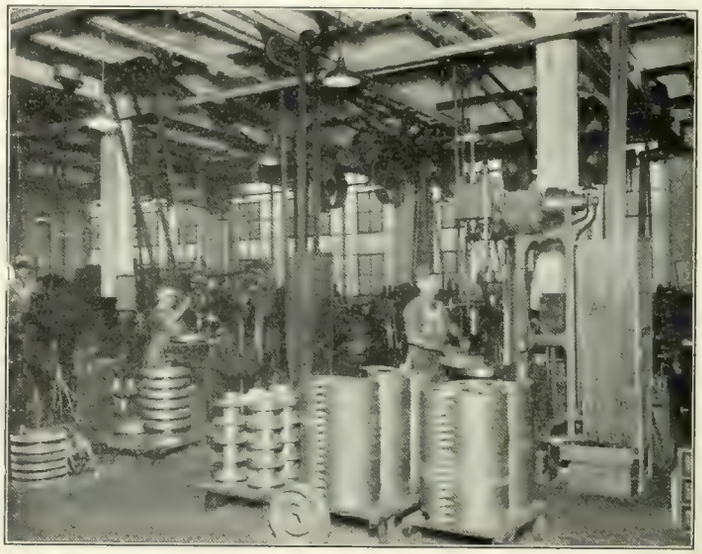


FIG. 8 LOCAL MACHINE TOOLS FOR SPECIAL JOBS ON ROUND WORK BETWEEN DEPARTMENTS

the same manner. Keyseaters, drilling and milling machines are conveniently placed for essential intermediate operations occurring between the progressive round operations.

### SPECIAL JOBS

There are several special jobs that are known by the work that is assigned to these special machine groups. The "gear job" is provided with turning, milling, broaching, and gear-cutting machines. The "cylinder job" is provided with vertical and horizontal milling machines, radial and multiple-type drilling machines, lathes, horizontal boring and cylindrical-type grinding machines. The "cam job" is provided with turning, milling, drilling and cam-cutting machines. Most all of these special jobs have all the machine tools that are necessary to completely machine the part on the floor and in the department where the work is started. Wherever it is practical, these special jobs are organized to save trucking, fix responsibility, and expedite the work.

[This article will be continued in the March issue.—The Editors.]

# Unfair Selling Prices

## Dangerous Fallacies

By W. L. CHURCHILL

*Consulting Engineer*

IN a recent article[1] I called attention to the low average level of profits generally earned by manufacturing enterprises. Figures available on this subject indicate an appalling lack of sense of responsibility to the stockholders.

With more than 70 per cent of manufacturers earning less than $5000 per year, and with the large proportions of earnings that are turned back into new buildings, equipment, advertising campaigns, or simply held as cash reserves, stockholders of manufacturing enterprises receive ridiculously small returns on their investments.

There is no necessity for this situation as is amply proven by the less than 30 per cent of manufacturing enterprises that do intelligently safeguard the stockholders' interests, and pay liberal dividends year after year. Even these firms could be more liberal to their stockholders, and maintain more stable dividend rates if they were not forced to meet competition in which the stockholders' interests are ignored.

The Illinois Manufacturers Cost Association has brought out a report "Financial Burden in Cost" that emphasizes this lack of responsibility. The concluding paragraph states:

> From a moral, financial and sound business standpoint, stockholders are just as much entitled to reasonable returns in the shape of dividends as bondholders are entitled to their returns in the shape of interest. The management of every business and industrial organization assumes a serious responsibility when it accepts stockholders' money. It should expect to meet this responsibility at all times.

### Why Stockholders' Interests Are Forgotten

The management of practically every business believes it is meeting this responsibility to the best of its ability. The reason that stockholders' interests are apparently ignored in the fixing of many selling prices is the belief that by ignoring profit, the reduced prices will bring in more than compensating volume of business. Many will even figure with minute exactness the profits that will result from this anticipated increase in sales at the lowered prices.

Unfortunately for stockholders, no one management has a monopoly of the scheme of making profits by increasing or multiplying production, and when a number of competitors put on simultaneous campaigns for this purpose the producing capacity quickly exceeds the market. No one gets all the business he needs to earn his stockholders' profits, at the price levels developed. The error of the various managements lies in pricing unfairly, that is, to their stockholders, in the expectation that the unfair prices will quickly develop markets that will make the prices fair. It is a form of speculating with stockholders' money that has proven very unprofitable to stockholders, and is largely responsible for the generally low repute of "Industrials" as investments.

Until profit to stockholders is considered as an obligation and is insisted upon as being made a part of the sales price of every unit manufactured, this prevailing low regard for "Industrials" will continue.

Owner management is even more prone to disregard profit as an obligation than is hired management. Many owners of enterprises assume that their personal familiarity with their business and their intimate knowledge of its technique and conditions enables them to produce and sell at lower prices than concerns depending upon salaried officers to operate the business.

On the strength of such assumption, prices of manufactured commodities are placed at unprofitable levels, even when costs may indicate their unprofitableness. The fact that employee managed concerns quote certain prices is sufficient excuse for the owner managed enterprise to quote lower prices on the theory that, "if they can make the goods at that price we can make them for less."

### Typical Case of Little Profit

A typical example is that of an enterprising, energetic manufacturer who by dint of hard work and shrewd management over a period of years, had developed a business producing annually well over a quarter of a million dollars worth of goods, and earning in net profits $10,000 to $15,000 annually.

His products were copies (chiefly) of three or four larger firms. He would first get their prices, then make his a shade lower, and then by his resourcefulness and ingenuity he would find ways to fill his orders at a profit, even though this profit was small. This practice, carried over a period of years, had gradually depressed the price level so that no one in the business was making adequate returns on his investment, despite the fact that they were producing a necessity with a definite and established market in which low prices effected no increase in consumption.

Some of the principal manufacturers brought about

[1] "Dangerous Selling Prices," August 1925 issue, p. 79.

an industrial survey which disclosed that the combined effect of the price competition had eventually so depressed price levels that they needed elevating 35 per cent to insure fair returns to stockholders.

Instead of being elated over a net profit of $10,000 to $15,000, the owner manager was brought to realize that his investment was entitled to ten times this return, and that it was only necessary for him properly to price his essential products to enable him to obtain this only fair profit.

### PROFIT IDEALS TOO LOW

This case also illustrates another phase of injustice to stockholders due to profit ideals being too low. If the dividend rate aimed at is but little more than savings bank interest, the possibility of continuous earnings is very remote.

Surprisingly few manufacturers have a proper conception of what their stockholders are entitled to for the risk they take and for the weary periods of patient waiting they are often put to between dividend payments. A recent survey of 40 manufacturing firms disclosed that only five had profit ideals that were fair to their stockholders, while the other 35 were complacent over inadequate returns or were reconciled to their meagreness.

The differences in ideals were very marked. One owner manager prided himself that he didn't care for profit so long as he could keep his one hundred odd people employed. The other profit ideals differed so that the highest required more than six times the rate of profit of the lowest in the same industry.

### ON WHAT ARE PROFITS EARNED?

The differences are due to lack of uniform conception as to what a manufacturer has to earn profits on. The firm operating largely with borrowed money in low priced rented quarters, with cheap or second hand equipment often figures that its capital invested is very small and consequently its net earnings need be but a trifle as compared with the firm owning modern buildings and equipment. It is sometimes difficult to bring the under-capitalized firm to a full realization of its earning requirements, but when this is done it is generally found to equal, approximately, and frequently to exceed the fully equipped and adequately financed institution. Rarely has the former any advantages over the latter that can be reflected in selling prices if stockholders are properly considered.

One of the explanations for this is in the additional cost of maintaining and replacing old or cheap equipment over that of newer and more modern machinery and the generally increased output per producing unit from the latter.

Another phase of unfairness to stockholders is in the lack of proper maintenance of the property represented by the stockholders' investment. Repairs are neglected for temporary saving in costs so that prices may be lowered, and depreciation is arbitrarily reduced for the same purpose or to make a fictitious showing of profit on the profit and loss statement.

Almost any industry that has not been paying satisfactory dividends for a few years will reflect this condition of its earnings (or lack of earnings) in the appearance of its buildings and equipment. One does not need to read balance sheets of some concerns to know that they are not paying stockholders good dividends. The shabby, unkempt buildings, lack of paint and cleanliness, leaky roofs, broken windows unmended, all point to lack of funds to keep stockholders' capital intact. Machinery in poor condition, and lack of modern equipment and facilities all point to the same thing and should be the warning to stockholders that their investment is deteriorating, even if some sort of dividends are forthcoming.

Few manufacturers know how much they should spend to keep their plants and all of their equipment in condition to earn profits. Perhaps still fewer appreciate what they should reserve from selling prices to insure keeping their equipment up-to-date. They are too apt to depend on an arbitrary bookkeeping figure as a basis for property maintenance and not enough upon sound judgment as to the requirements of a business.

### ONLY $450 FOR DEPRECIATION

One manufacturer was charging $450 per year depreciation against an old worn-out plant, because good bookkeeping demanded this charge. In actuality he needed over $8000 per year to replace the older units in his equipment with more modern ones to enable him to make profits for his stockholders. His selling prices included only the $450 until revised to a proper profit ideal.

There is sufficient handicap against the stockholder in the general lack of uniformity in ideas and ideals as to his proper interests in the selling prices of manufactured goods, not to impose the further danger of impairing his investment by failure to provide for proper care of his property. Failure to provide for maintaining its modernity and profit-earning ability would seem sufficient excuse to make him more chary than he is to invest in industrial enterprises. On top of all of this, however, he suffers the further indignity of having selling prices made up with his interests deliberately reduced and even entirely omitted.

Cost systems and cost departments have been devised and installed ostensibly for the improvement of profits. In reality they are often used for the exclusive benefit of customers and only to insure the stockholders against the actual loss of their investment.

Seemingly, the more thorough the cost knowledge in many industrial plants the lower they dare to price their goods, since it enables them to determine just where profit ceases and loss begins. Since profits are not considered an obligation, and since low prices bring the business, they price without profit or at less than a fair profit, and customers get the goods below their real value and at the sacrifice of the stockholders.

This condition is becoming more pronounced as production capacity exceeds the absorbing capacity of the market. None, or very little, of this pricing without profit or pricing with less than fair profit is intended to deprive stockholders of dividends. In fact, quite the reverse is the intention, as the hope and expectation is always that the low price will bring additional business or that it will hold business that is liable to be lost to others if the price is not reduced. Sometimes retaliation against competitors who have taken or threaten to take business away is the motive, but even then it is the thought that one such salutary lesson will be sufficient to deter the offender from a repetition of supposed price cutting.

### Motives for Low Prices

Whatever the motive behind low prices the stockholder is always the loser. "Profit is the first item to be reduced or omitted when price reductions are under consideration."

In almost any cost department of an industry producing competitive goods you may hear such remarks as the following: "How low must we go to get the business?" When this question is answered the remark will be, "Well, we can do it all right but without a profit. We won't make any money, neither will we lose any." Or some one will say, "It will bring us a new account," or, "It will bring our overhead down anyway." Any of a dozen or more fallacious reasons why the goods should be sold without due regard for the stockholder may be made.

The stockholder has no one to represent him with the courage to say, "No!" and with the authority to see that the order was not taken unless he was recompensed as well as the people who supplied materials and labor, and who may have loaned money (on security) to enable the order to be filled.

When the financial reports are made to stockholders the usual excuse for the unsatisfactory showing is that competition has forced low prices. This excuse is made in good faith and few manufacturers alone can entirely overcome the handicaps of competition of improperly advised business opponents.

When forced to sell in a market needing substantially higher price levels even though partially responsible for these levels he finds it difficult to obtain fair prices for a reasonable volume of goods.

Manufacturers who set out to obtain fair prices regardless of competitive conditions often obtain surprising co-operation from their trade. They may not obtain the full volume of business formerly considered as their standard of production volume, but the net income almost invariably improves and stockholders receive better returns on their investment.

### Profits from Fair Prices

Manufacturers have so long accustomed themselves to seeking profits via the big volume channel that it requires a considerable mental wrench to accept the possibility of earning the desired profits by the "fair pricing" channel. Mental wrenches are unpleasant.

Accustomed to seeking big outlets, and figuring on the reduced selling costs due to a few large gilt-edged accounts as against numerous smaller and more precarious accounts he is apt to overlook the greater ease with which fair prices can be obtained in the less competitive markets.

One recent survey of six firms catering to the same class of trade showed that the firm with the lowest selling costs made the least for its stockholders, while the firm with the highest costs made the most, although none made reasonably fair returns on their investments and efforts. The firm with the lowest selling cost sold only to a few huge accounts but at prices that left them practically no profit for their stockholders. The firm with the heavy selling cost catered to smaller but more numerous accounts and despite the added credit risks, lessened tonnage and greater sales effort required, secured prices that covered the extra costs and left a larger profit.

The moral of this survey is that organized buyers, by the power of their size and organization, have been able to depress the price levels below a fair return to stockholders of the manufacturers supplying their needs. Few of these large buyers have any desire to be unfair to the firms with whom they do business. More often it is the fault of the manufacturers themselves voluntarily quoting prices that are unfair to themselves in their eagerness to get big business. The Big Order is the siren that lures many manufacturers to the troubled sea of deficits and frequently to disaster for which the stockholder pays and pays.

The arguments used by manufacturers to justify ignoring their obligations to their stockholders when making these sales are as varied as human reasoning. One manufacturer will deliberately quote unprofitable prices until his factory is reasonably well filled with business and then he will assume an independent attitude and advance his prices to additional customers with the idea that these customers will earn him his profits. Another in the same line will reverse his reasoning and accept only profitable business until he has a comfortable quota on hand; then he will accept all offering business at any price above cost of material and labor as so much extra velvet.

Of course, neither firm makes a fair profit and their divergent sales policies simply add to the demoralization of an already chaotic market condition.

### Why Not "One Price System?"

Manufacturers in many lines have yet to learn the value of the "one-price" system now all but universal in retail trade. When manufacturers give their salesmen price lists with instructions to "shade" if they have to, they simply rob stockholders of so much profit. The shading or reduction from fair prices means the stockholder hands the customer the difference between the fair price and the price sold for. This is done without asking his permission but with the idea that

if it was not done he would lose more by loss of the whole order.

How any manufacturers can justify different prices for the same goods to different customers buying the same quantities is a mystery beyond the lay mind to understand. Yet this is a very common practice and partially explains the necessity for many manufacturers making every sale a matter of special effort and expense. Customers never being sure of their having obtained the lowest prices and best terms refuse to establish a permanent connection, or send repeat orders without specific bargaining over each. All this adds to cost and deprives the stockholder of a part of his fair remuneration.

### TRYING TO "GET THE ACCOUNT"

This pernicious practice feeds on itself and prevents even the fair minded manufacturer doing business in what should be the most satisfactory method for his customers. Naming fair prices and a one-price policy, he finds competitors who have lost out in their competitive bargaining with other customers, rushing to his established customers and deliberately tempting them away from him by low prices often deliberately at losing figures to "get the account." Result! the stockholders of the price cutting firm lose their profits, and the fair price firm because of lessened business also fails to pay its stockholders as much as it otherwise would.

No one profits by these tactics; not even the consuming public as the additional selling costs imposed by them must be borne by the ultimate consumer.

Many manufacturers even put it up to their sales organization to make their prices and price lists on the basis of a belief that they know best what the prevailing prices are and what can be obtained for their products. This practice is not confined to firms who do not know their costs but many who have most elaborate and complete systems will ignore them when pricing products.

### FEAR OF PRICES BASED ON COSTS

When prices are submitted that are based upon costs, many manufacturers will ignore them stating that "these prices will not do in our particular line of business. We have to make prices according to competition not according to costs." And again the stockholder is left out of all consideration.

The stockholder is not organized to protect his own interests, and they simply are not protected. It is only by manufacturers intelligently accepting their responsibility towards their stockholders that they can be protected. Most manufacturers recognize the injustice that is being done to their stockholders but feel that the trouble is inherent in manufacturing, or in their particular line of industry.

Many owner-managers chafe and fret over the unsatisfactory conditions of their industry and wish they could get out of it. They feel that they have simply gotten into a poor industry and if they were out of it they would choose a better one, where competition did not force losing prices.

It is unnecessary for any worthy business to tolerate conditions that are unfair to their stockholders. It only needs a full realization of this fact to induce a study of the underlying causes for low profits. These will be found to be so few and elementary that their correction and elimination can be quickly effected and stockholders be 'let in' for profits that will justify their faith and confidence instead of "being 'left out' in the cold."

The trouble is not in competition nor in excessive capacity or production, but lack of intelligent conception of the effect of all of these influences and others upon proper selling prices. Fair pricing insists upon stockholders profit being included at all times.

To induce this it becomes necessary to know: 1, What should that profit be; 2, how should it be allocated to the different products; and, 3, what volume of production is necessary to insure the normal profit being earned.

To answer the first question requires more than a snap judgment rule of earning some fixed ratio to sales, or to investment. It calls for an intelligent analysis of the industry's characteristics, best conducted by someone with facilities to study a number of firms in similar lines and whose conclusions will appeal to the judgment of the firms interested as being sound and rational.

The second question calls for uniformity in understanding among all members of an industry, and uniform application to different products in order that selling prices may be comparable.

The third question can best be answered through group knowledge of the collective producing capacity of an industry and its relation to output or sales.

### WORK FOR MANUFACTURER'S ASSOCIATIONS

Here is one large item of justification for manufacturers associations. The collected reports of capacity production, sales, etc., form bases for pricing guides comparable to our government reports of wheat, cotton and other staples.

Several groups of manufacturers have already undertaken a program of education of members of their industries for the purpose of insuring protection to stockholders.

The results being obtained from these efforts justifies the belief that as confidence grows in the permanency of the betterment secured, more manufacturers will adopt the educational method of improving and stabilizing profits. With the growth of the idea more associations will form and those already organized will find a greater scope of usefulness.

When men are thinking along similar lines it is easy to get together and work out mutual problems. When they are in antagonistic frame of mind harboring suspicion and resentment of each others business methods and activities it is very difficult to get concerted action for even the simplest of mutual problems.

# Scientific Planning for the New Western Electric Plant

By O. C. SPURLING

*Engineer of Plant, Western Electric Company*

THE continuously growing demand for telephone service throughout the Bell System has caused a steady expansion of the manufacturing facilities of the Western Electric Company, which makes most of the nation's telephones and telephone equipment.

In 1900 the Company purchased some 200 acres of prairie land at Hawthorne on the outskirts of Chicago, Illinois. On that tract there has been constructed, year by year, on a comprehensive plan, a great plant known as the Hawthorne Works. But even this works, with its floor area of eighty acres, was inadequate, and further increase of manufacturing facilities was deemed necessary.

A study was made to determine whether increased capacity could be provided advantageously at Hawthorne or at some other place. The initial investigation resulted in a decision to select a new site and develop a new factory, and then followed a series of studies looking to the selection of a location.

The economic studies went thoroughly into such factors as the source and transportation of raw materials, including the time elements involved in obtaining materials, the market for the finished products and the cost and method of distribution, whether by truck, train or water. They weighed carefully the possibility of shipping the product from an eastern waterfront location to the Pacific coast by way of the Panama Canal. Another very important consideration was the labor market.

The result of these investigations indicated that a location within 50 miles of New York City would be most economical from all standpoints.

The Company then undertook a close scrutiny of available sites in the district selected. The essential features to be considered were railroad facilities, watershipping, labor market and local transportation of employees.

A total of 42 properties was investigated, 24 of which were waterfront properties, the remaining 18 being inland sites. Of the properties having a water frontage, five were on Long Island, two in the Bronx, three

FIG. 1 POWER HOUSE AND MANUFACTURING BUILDINGS FROM THE CENTRAL RAILROAD BASIN

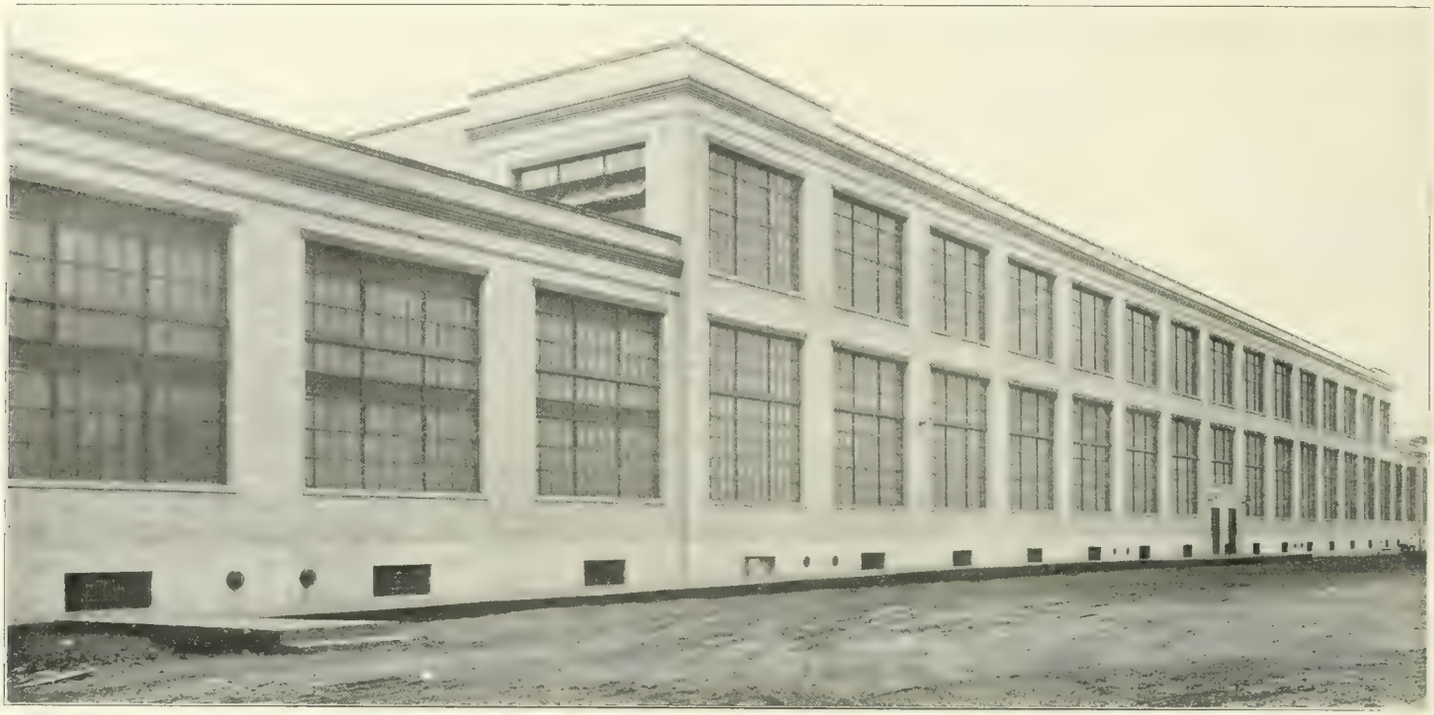


FIG. 2 A HANDSOME EXTERIOR HAS BEEN OBTAINED BY THE USE OF SELECTED AND MATCHED BRICK

on Staten Island, and the others were all in New Jersey, extending from Paterson on the north to Perth Amboy on the south. In order to be assured that all available waterfront property had been given consideration, a tour by boat was made of the New York upper bay district, the Arthur Kill and the Kill von Kull Rivers, Newark Bay and the Passaic and Hackensack Rivers.

### KEARNY SITE FINALLY SELECTED

After due consideration of all properties investigated, it appeared that the Kearny meadow site more closely approximated important requisites than any of the others, and after borings and pile tests had been conducted in order to give careful consideration both from an engineering and a financial standpoint, the site on the Kearny peninsula was selected and the property was purchased and title taken on February 9, 1923.

The site selected fronts on the Passaic River, the southern edge of the property abutting the right of way of the New York and Newark Branch of the Central Railroad of New Jersey. The Lincoln Highway is but a short distance north of the property and is reached easily by a new street, Central Avenue.

The chief advantages which determined the final selection of this site were: (1) Its close proximity to Newark and Jersey City, which are considered very desirable labor markets; (2) convenient transportation for employees, available over the New York-Newark Branch of the Central Railroad of New Jersey, and by street car and bus service along the Lincoln Highway; and (3) good railroad freight service. The location was considered most desirable from a shipping and receiving standpoint, as all shipments for the plant can be delivered direct by rail or water, and the delivery of finished products can be handled in the same manner. The site also offers a central position for local and long distance shipments by automobile truck, and is accessible to the new vehicular tunnel under construction from Jersey City to Manhattan.

It was apparent that piling would have to be driven to form a foundation for the entire plant. This requirement involved a careful study of the initial and ultimate location of all heavy equipment. It was obviously uneconomical to provide excess piling at places where only light loads were to be carried. At the same time, machines requiring especially strong supports could not later be removed to locations having insufficient piling to bear concentrated loads.

The sizes and shapes of the various buildings were determined after thorough study, involving the figuring of machine floor space, operating space, storage space, a comprehensive system of main aisles, and the proper lighting and ventilation. Other vital factors were the arrangement of tracks for receiving and shipping material and finished equipment.

### PLANS FOR ULTIMATE DEVELOPMENT

The plans involved provision for an ultimate development of the whole site into a works to employ eventually some 30,000 people. The growth toward this ultimate development will come over a period of years, during which a few units at a time will be constructed, according to current needs.

The first unit to be constructed was for the manufacture of lead-covered telephone cable. For such work as the manufacture of lead-covered cable, a single-story type of building is considered most satis-

factory because of the heavy weights of material and equipment. This type of construction also lends itself to continuity of passage of the product through the plant, from the receiving of the raw materials to the shipment of the finished product. The next development authorized was a series of multi-story buildings for the manufacture of telephone switchboards. The number of floors—six—was arrived at from past experience.

The Kearny Works will supply its products to the Bell System and it will share with the Hawthorne works the responsibility for a dependable source of supply. A prime requisite for dependability is a minimum risk of interference with manufacturing operations by fire, and consequently fire-resisting buildings were chosen.

FIG. 3 TYPICAL CONSTRUCTION AND LIGHTING IN THE CABLE [illegible]

Steel was adopted as the preferable frame and roof construction for the cable shops—which consist of wide, single-story buildings. Steel framework was also decided upon as the most feasible type for a power house.

### CONSTRUCTION OF MULTI-STORY BUILDINGS

In the multi-story buildings, reinforced concrete design throughout would have resulted in a lower building cost, but columns to support such construction would have been much larger and would have interferred with the economical placing of manufacturing equipment. Hence, steel columns, supporting steel floor framing which when protected with concrete or terra cotta is fire-resisting, were selected. Reinforced concrete was used, however, in the first floor, because of its strength and cheapness, but structural segmental tile was selected for the manufacturing floors above the first, to make it possible to cut through the floor wherever desired without sacrificing its strength.

The exterior walls were constructed of buff face brick trimmed with architectural terra cotta. See Fig. 2.

A hot water heating system was selected in preference to all others because, with such a system, the amount of heat furnished to the buildings can be easily regulated to meet the requirements of different weather conditions. The close control possible with the hot water avoids furnishing too little or too much heat, and not only makes working conditions very much better, but saves the considerable amount of money wasted when steam heating is used and windows are opened during mild weather to cool off the buildings.

A sprinkler system was installed to extinguish fires, if any should occur, while they are still small. The savings in insurance premiums more than absorbed the fixed charges on the investment in the system.

Modern types of plumbing fixtures were chosen with a view to maintaining the best sanitary conditions

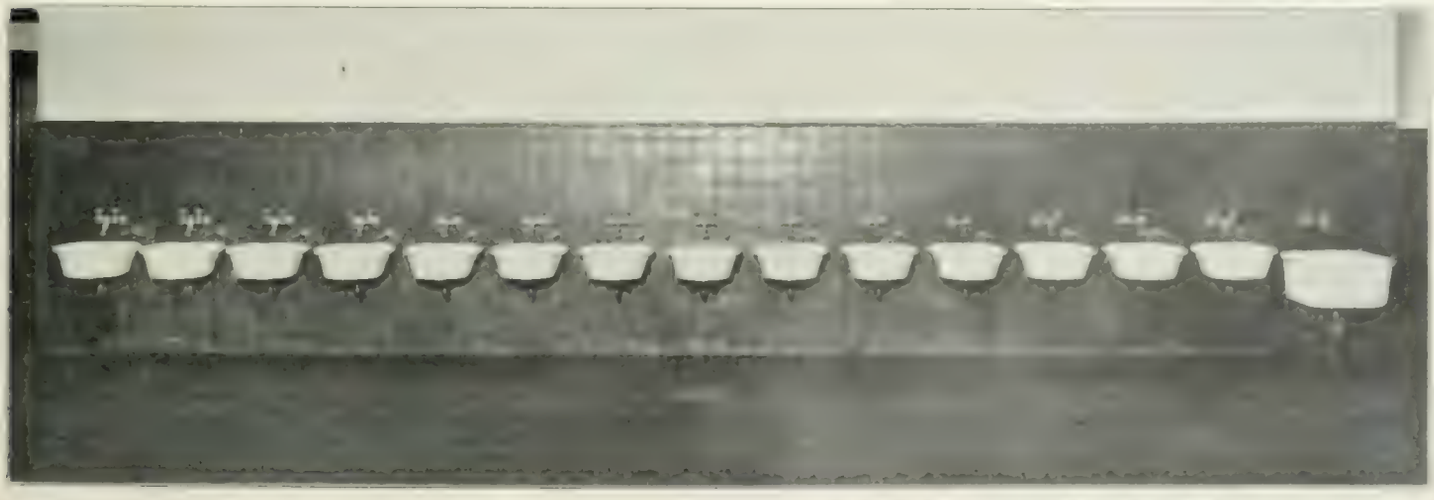


FIG. 4 LAVATORIES ARE IN THE MANUFACTURING DEPARTMENTS ON [illegible]

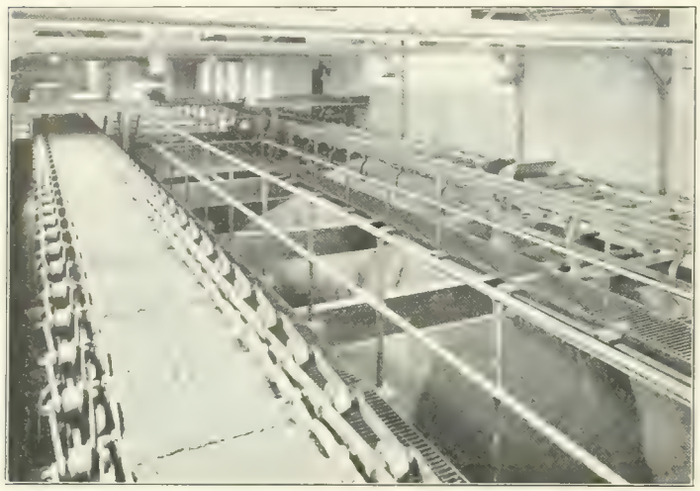


FIG. 5 BUCKET CONVEYORS AND COAL BUNKERS

readily and cheaply. Tile floors and wainscoting have been installed in toilet rooms, with this in mind. Piping is concealed to leave the walls clear and accessible for easy cleaning. See Fig. 4.

Combination faucets are used in all lavatories so that employees may use running water of any temperature desired.

Modern types of lighting fixtures have been adopted, with generous amounts of illumination.

The coal and ash handling equipment is designed to permit the receiving of coal and removal of ashes by rail, water, or truck. Coal storage facilities take care of three months' supply. Either hard or soft coal can be used. The boiler settings are arranged, however, so that oil fuel may be used if it should be desirable to make this change at any time.

### COAL AND ASH HANDLING BUILDING

The coal and ash handling building is connected to the power house proper by a bridge near the roof level and by a tunnel at the basement grade. This building is adjacent to the bulkheads so that barge as well as railroad shipments can be handled directly.

In this structure, which is served by two railroad tracks, the coal is handled entirely by automatic machinery. It is dumped from the cars directly into a track hopper feeding bucket conveyors. These conveyors carry the coal up and across the connecting bridge to bunkers above the boilers. See Figs. 5 and 6. The buckets of the conveyors, which are in the form of an endless chain, then pass down to the basement of the boiler room and back through the tunnel to the track hopper again. This same conveyor system handles the ashes from the ash hoppers below the boilers to the ash bunkers in the coal and ash handling building. From these bunkers the ashes are chuted directly into cars, wagons, trucks, or an ash receiver on the bulkhead deck from which the ashes can be loaded by crane to barges. Thus, from the time the coal is loaded into the cars at the mine until the ashes are ready to be hauled away, all handling is mechanical.

In the turbine room are installed one 1500 kw. non-condensing, one 1500 kw. and one 5000 kw. condensing turbo-generators, two exciters, two boiler feed pumps and the switchboards. Provision has been made for the future installation of turbo-generators to bring the capacity up to approximately 23,000 kw., as required.

In the basement of the power house are located the water filter and refrigerating machinery for drinking water, the hot water heater and pumps for supplying hot water to the heating system, and the condensers, air compressor and other auxiliary equipment.

The question of manufacturing equipment was given the most careful attention, the endeavor being not to put in any equipment or fixtures until the requirements had been thoroughly considered and the most satisfactory type decided upon. In many cases completely new designs have been worked out, resulting in economy of floor space, improvement of quality, decrease of manufacturing cost, etc.

Work on the cable buildings began in April 1923, with the dredging and removal of some 300,000 cubic yards of mud along the river frontage of the property to permit construction of a bulkhead. Then followed the pile driving operations during which 36,675 piles were placed, 69,901 cubic yards of earth excavated and 1,000 barge loads of filling used. Work on the superstructures of the cable buildings was started in January 1924. Some of the steel trusses used in the roofing of these buildings are 120 ft. long and required three flat cars to transport them to the job.

FIG. 6 BOILER EQUIPMENT IS OF THE MOST MODERN TYPE

Pending the completion of the first units of the Kearny Works, temporary plants were leased in Jersey City and Newark. Personnel was trained (principally under supervisors brought from the Hawthorne Works at Chicago) at the Waverly Shops at Newark and

the West Side Shops at Jersey City, and manufacturing operations were begun in these places.

Meanwhile, other employees, selected for their fitness for doing specific kinds of supervisory work, were hired in the Metropolitan district and sent to the Hawthorne Works for training in the respective positions they eventually would hold at the Kearny Works.

The entire plant and equipment was laid out and the building program handled by the organization of the Engineer of the Plant of the Western Electric Company. McKenzie, Voorhees and Gmelin acted as consulting architects; the J. G. White Engineering Corporation, and also Charles W. Staniford, as consulting engineers.

FIG. 7 STORAGE BATTERY LOCOMOTIVE CRANE OF 15 TONS CAPACITY

TABLE 1. SUMMARY OF DATA ON WESTERN ELECTRIC KEARNY PLANT

Data on buildings covers completed portion only

| | |
|---|---|
| Location | Kearny, N. J. |
| Construction | Structural steel frame. Exterior walls—common brick and terra cotta partition tile. Exterior walls—common brick faced with light cream Cleveland brick. Exterior trim—pressed stone, sash, gutters, cornices and copings, made up of red architectural terra cotta with red pressed face brick trim. |
| Foundations, substructure | Reinforced concrete piles, timber decking and concrete footings. Reinforced concrete piles, timber decking and concrete footings. Buildings 1 and 2 on wood floating piers, capped with concrete piers supporting reinforced concrete columns which carry first floor concrete. In multi-story buildings, steel columns are carried down to piers encased in concrete. |
| Grounds | Filled-in land, with no landscape gardening done as yet. Bulkhead 1671 ft. long, and providing clear depth of 26 ft. along Passaic River. Basements of buildings located slightly above high tide level. |
| Property | Approximately 67 acres, 1,000 ft. wide |
| Buildings erected | Two 4-story reinforced concrete factory buildings, five (5) of which are each 450 ft. long and one (1) 200 ft. long. One power plant 182 ft. long, 118 ft. wide and 90 ft. high. One gas house 60 ft. long by 45 ft. wide and 57 ft. high. One pump house 28 ft. long by 12 ft. wide and 15 ft. high. |
| Buildings now under construction | One story and basement addition to Building No. 1, two one-story structures, one 260 ft. long, 60 ft. wide and 35 ft. high, the other 237 ft. long, 40 ft. wide and 35 ft. high; two five-story structures, one building 260 ft. long, 60 ft. wide and 85 ft. high; six six-story structures each 300 ft. long, 69 ft. wide and 100 ft. high; also one building known as the Destructor Building, 82 ft. long, 61.5 ft. wide and 40 ft. high. |
| Floor area, present | 225,037 net total sq. ft. in manufacturing depts., offices, and sections now used for temporary purposes |
| Floor area, in part under construction | 647,173 total sq. ft. |
| Total floor area present and [illegible] | 872,210 sq. ft. |
| Architecture | Modern industrial design. |
| Neighborhood | Entirely industrial. |
| Fences | Wire fence on 3 sides. |
| Employees | Both men and girls in shops and offices. |
| Transportation facilities | Central Railroad of New Jersey, Pennsylvania Railroad, Lehigh Valley Railroad, Erie Railroad, Baltimore & Ohio Railroad, Lackawanna Railroad, Jersey Central Railroad, Delaware, Lackawanna & Western Railroad, New York, Susquehanna & Western Railroad, Lehigh & New England Railroad, Lehigh & Hudson River Railroad, Boston & Maine Railroad, New York, New Haven & Hartford Railroad, Long Island Railroad, Pennsylvania Railroad, Hudson & Manhattan Railroad, Hudson & Manhattan Railroad, Hudson & Manhattan

| | |
|---|---|
| | 19 ft. 9 in. one way and from 19 to 20 ft. across departments. Intensity in shops 7 to 8 candlepower 36 in. above floor. Office also equipped with enclosed overhead lights to give 10 to 11 candlepower at desk height. |
| Heating | Hot water heat obtained from exhaust steam of certain power house units, passed through an Alberger Spiraflow closed heater. Heating lines run through tunnels to various buildings. About 60,000 sq. ft. of radiation now installed, or approximately 1 sq. ft. for every 100 cu. ft. of space to be heated. Wall and column type radiators used, installed under windows and in monitors. |
| Boilers | Four 800-hp. Babcock and Wilcox boilers, to operate at 300 lb. pressure, 200 deg. superheat. Two Kingston Webster, to operate at 100 lb. pressure. |
| Stokers | Chain, 11 ft. wide by 18 ft. 4 in. long. |
| Feed water pumps | Two centrifugal, 4-stage, 4-in. Alberger. |
| Feed water heater | One Elliot. City water used. |
| Feed water regulator | Copes. |
| Forced draft | Four size-90 B. F. Sturtevant fans, Turbovane type. |
| Stack | Buff brick 200 ft. high, 12 ft. 6 in. diam. inside at top. Alphons Custodis. |
| Boiler instruments | Bailey boiler meters for steam flow, draft and quantity of air. Ashton pressure gages. |
| Turbines | Two 1500-kw. and one 5000-kw. General Electric turbo-generators. 275 lb. press. 200 deg. superheat, 3600 R. P. M. |
| Exciters | Two 75-kw. Western Electric, turbine-driven. |
| Switchboard equipment | General Electric. Taylor temperature gages used. |
| Condensers | Alberger Spiraflow surface condensers equipped with condensate and circulating pumps (centrifugals). |
| Water pumps | Used on service lines. City water used for drinking purposes after refrigeration. |
| Fire pumps | Two 1500 gal. per min. Le Courtenay centrifugal. |
| Coal handling | Separate building houses bucket conveyor system, fed from track hopper into which gondola cars dump. Coal delivered to concrete overhead storage bunkers in front of boilers, and thence to stokers. Buckwheat coal burned. Crusher provided, in case coal is frozen. R. H. Beaumont and Link Belt equipment, Western Electric motor-drive. |
| Ash handling | Bucket conveyors of coal system pass down under ash hoppers leading from boilers. They carry ashes underground to separate building mentioned above, and there elevate them and dump them into overhead bin, for discharge to gondola cars or trucks taking them out of the yard. |
| Coal storage | R. H. Beaumont drag conveyor system. Space for 25,000 tons of buckwheat coal in yard adjacent to power house. |
| Transmission system | Underground, in tunnels. |
| Compressed air | Ingersoll Rand compressor, 14 by 16 in., 2-stage, 1500 cu. ft. per min., at 100 lb. pressure, direct driven by synchronous motor. |
| Water tanks | One rectangular expansion tank, 12 by 5 by 4 ft., 1680 gal. One cylindrical hot water tank, 11 by 5 by 3 ft., 1500 gal. One rectangular surge tank, 18 by 6 by 8 ft., 6100 gal. One cylindrical cold water tank, 11 by 5 by 3 ft., 1500 gal. |
| Machine-drive | Direct drive throughout, by means of Western Electric motors, each suited to individual requirements. |
| Air conditioning | Carrier Air Conditioning Company's system used to maintain 110 deg. fahr. and 10 per cent humidity, employed after drying cable preliminary to lead-covering. |
| Cranes and hoists | Power house—one 20 ton, span of 20 feet; one 30 ton, span of 50 feet. Cable buildings—two 5 ton, span of 60 feet; one 25 ton, span of 60 feet; one 50 ton, span of 59 feet. All Shaw make. |
| Transportation equipment | General Electric locomotive (storage battery of 17 cars capacity). Brown Hoisting Machinery Company's 15 ton, 55 ft. boom storage battery crane used in yard (only one of its kind in existence). Batteries recharged at power house. |
| Shop trucks | Special types developed by owner's engineering department for incoming materials, inspection department, full reels of wire, empty reels, etc. |
| Conveyor systems | Only one in use, in shipping department, to receive incoming empty cable reels. |
| Sprinklers | Complete system of automatic sprinklers installed in all buildings. |
| Fire extinguishers | Hand extinguishers at convenient points. |
| Fire hose and monitors | Monitors on roofs of buildings, covering adjoining grounds and wharf front. Hose connections throughout all floors. |
| Fire alarms | One city alarm box located in the plant. Local alarm boxes throughout all floors. |
| Storage shelving and racks | Designed and built by owner. |
| Factory benches | Cast iron legs, maple tops, some covered with galvanized sheet with concealed nails. Definite company standards. |
| Factory stools | All wood. |
| Lockers | Steel lockers provided, one for each employee. Located in departments where employees work. |
| Safeguards | Aisles protected by pipe railings. Machines protected by expanded metal guards on structural steel frames. |
| Domestic hot water heaters | Heated by steam. Automatic temperature control. |
| Wash bowls | Vitreous ware, individual wall-type. In shops these are mounted on tiled walls along the outside of the toilets, with tiled floors beneath. |
| Closets and urinals | Vitreous ware. |
| Toilet partitions | Steel construction. |
| Showers | In special locations only. |
| Shower partitions | Slate. |
| Drinking fountains | White porcelain, pedestal-type, installed about 100 ft. apart throughout the plant. |
| Plant communication | Western Electric telephones connect all important points in shop and office. |
| Time system | International Time Recording system, for in and out records. No job time cards used. |
| Hospital equipment | First aid equipment installed at present. Ultimate development includes a complete hospital. |
| Cafeteria | Very complete equipment to take care of 400 employees at one time. Now housed in one of the departments intended eventually for manufacturing, pending completion of building program. Wood tables with porcelain tops, wood chairs, dish washer, baking oven, electric stoves, mixer, vegetable chopper, cooking ovens, coffee percolator, bread slicer, meat slicer, are installed. Complete refrigeration system and boxes, employing ammonia. |

# Coal and Ash Handling at Quarter the Cost

THE Independent Towel Company, of Cleveland, operates its own power plant and receives its coal in motor-trucks.

The coal is chuted directly from the truck at the street-level to a hopper and elevator boot in the basement. From this point it is raised 54 ft. by means of an enclosed bucket elevator. The discharge spout of this elevator passes the coal to a drag-conveyor which extends approximately 63 ft. along the top of the coal bunker, this bunker having a total capacity of 260 tons. Gates in the conveyor trough permit the coal to be distributed to any part of the bunker desired. From this bunker it is fed to the stoker hoppers which feed it to the chain grates of the two 500 hp. boilers, an accurate check being kept on the amount of coal used by means of a recording weigher.

To dispose of the ashes, another drag-conveyor was installed in the basement. This conveyor, about 33 ft. long, runs alongside the ashpit doors. About once or twice a day the accumulated ashes are raked on to the conveyor and deposited, by means of the same bucket elevator which feeds the coal system, to an ash hopper adjoining the coal bunker itself. In order to permit both coal and ashes to be thus handled by the same elevator, the discharge spout is provided with a two-way gate by which the material elevated may be directed either to the upper conveyor, or released so as to drop at once into the ash hopper immediately below the spout.

The method of removing the ashes from the plant is ingenious. Since they must be removed by motor trucks under a cartage contract, and since there is no certainty as to the exact time at which the trucks will arrive, special arrangements are made so that the driver himself can start up the discharging conveyor and fill his truck without help from the inside. For this purpose a discharge spout is provided on the outside of the building at a height of about nine ft. above street level. The driver backs the truck up under the chute, closes a switch on the side of the spout, and starts up the conveyor. As soon as the truck is filled he shuts off the conveyor and drives off.

The entire coal and ash handling equipment described above is driven from a single motor, a two-way clutch providing the means of moving the coal and ashes to their respective destinations. The whole installation was designed, manufactured and erected by the Stearns Conveyor Company, and has worked out very satisfactorily. E. E. Harr, superintendent of the plant, states that this method of handling has effected a saving of at least 75 per cent as compared with hand-shoveling.

# Offsets for High Manufacturing Costs

## How the Woodworking Industry Has Met the Situation

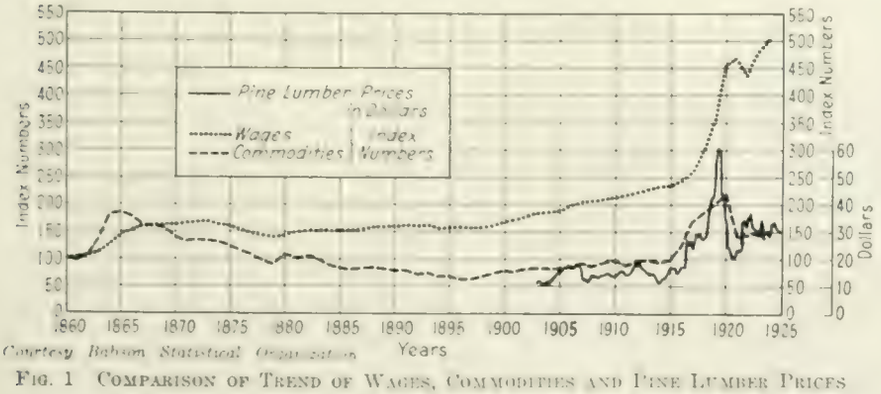
By THOMAS D. PERRY

*Secretary, Bigelow, Kent, Willard & Co., Inc.*

PREDICTION or prognostication of future business trends, whether by means of tabulations, charts and graphs, or by observation, opinion, and somewhat abstruse argument, is a favorite diversion for many, and not a few earn a well deserved livelihood thereby.

Some of these trends are so fundamental that they deserve most careful consideration, since they demand of executives adequate and prompt solutions. There are three trends clearly shaping into rather definite policies, and the effect of these on the woodworking industry is the basis of this article. They may be outlined as follows:

*First:* Raw materials, taken from below the earth's surface or cultivated as a crop above ground, are quite unlikely to decrease materially in value or cost. In the main, therefore, and with few exceptions, costs of manufacturing material will gradually increase.




Courtesy Babson Statistical Organization

FIG. 1 COMPARISON OF TREND OF WAGES, COMMODITIES AND PINE LUMBER PRICES

*Second:* The present scale of living and the prevailing wages of American labor are strongly established, and substantial retrogression in either is quite improbable. The purchasing power of the American working man will surely decrease as his living conditions are depressed, and the vicious cycle of decreased demand will inevitably undermine the manufacturer. Minor adjustments will always occur from time to time, with the ebb and flow of business volume, but the employer who strives to bring about conditions that will force lower wages will, in the last analysis, find himself crippling the sale of his own output.

*Third:* Sales prices, on the whole, cannot be expected to go much higher. The limit has been reached, and the buying public have come to feel that further increases are intolerable.

### WHAT THE GRAPHS SHOW

A graphic study of these three trends is only partially available, but the index of the cost of living from 1860 to date and the composite of pine lumber prices since 1904 are shown in Fig. 1, both supporting the statements made above.

It is obvious that, with no opportunity to raise prices, and a gradual but none the less certain and inevitable increase in the cost of material and labor, there is only one solution, i.e., holding manufacturing costs down by more intelligent and intensive utilization of material and labor.

Granting, for argument's sake, the correctness of the above statements, what must be done, and how should the intelligent executive direct the energies of himself and his staff in order to maintain existing factories on a profitable operating and a constructively growing basis? The answers are not hard to discover, although they may be much more difficult to apply successfully.

### ECONOMIC UTILIZATION

Material must be used with greater economy; either less material must be utilized or the proportion of waste and by-product reduced, or the same amount of material must be made to go further. In some cases it may mean the substitution of similarly efficient material at lower cost. Our present industrial waste is appalling! We are neglecting and exhausting our natural resources of timber and oil with little serious thought, and with even fewer constructive acts to insure adequate replenishment.

### BETTER RELATIONS

Labor is demanding constantly increasing wages and shorter hours, usually without an intention of giving equivalent productivity. Clear-headed and far-seeing manufacturers are willing and even anxious to have their help earn more, not by longer hours or gruelling

work at speeds that mean physical exhaustion, but by means of better equipment, more productive methods, more efficient factory arrangement, more elimination of unnecessary fatigue, more skilful training of apprentices, and more constructive thinking on the part of the worker.

Large profits are seldom made by wide margins between cost and selling prices, but nearly always by large volume with small margin of gains. High wages in the future (deservedly) will go to the employee who delivers a large volume of product to his employer as the result of his daily toil. Closer co-operation between employer and employee is most essential in approaching this ideal of higher wages and larger production.

### WHO IS RAISING PRICES?

The last ten years have witnessed extraordinary increases in the cost of living. The high cost of living has developed until it has become the cost of high living. Personal and family requirements have grown with, and often faster than, individual incomes. The spirit of thrift has suffered some staggering blows. Fortunately the reaction has set in, and spurred on by President Coolidge, national taxes are gradually decreasing, but few state, county and municipal taxes are yet on the down grade, although they may be expected to follow in time, unless unforeseen economic changes take place.

Everywhere comes a vigorous protest against the complexity and burden of our selling methods. Grocery stores are rapidly adopting "cash and carry" methods to reduce overhead and to lower prices, and in some lines buyers' strikes are threatened. Co-operative and mutual purchasing and jobbing organizations are appearing here and there. Government bureaus are finding and penalizing price agreements in restraint of trade. In fact, the whole spirit of the times is swinging strongly into channels of thrift; reducing expenses is a popular slogan; and national sanity in buying is again emerging.

Attempts to increase selling prices, under such conditions, are most unpopular, and few manufacturers are bold enough to breast such a tide of public sentiment. Few price increases are likely to survive long.

### WOODWORKING APPLICATION

Much of the writer's experience has come through some twenty years of intimate contact with the woodworking industries, and these branches of manufacturing offer an excellent field to study the three trends of stationary prices and stiffening costs of raw material and labor.

The utilization of wood is under more searching scrutiny than almost any other raw material, due largely to the growing realization of the impending shortage of available merchantable timber, and the inevitably long cycle of replacement by new growths. Every move in the direction of reforestation is to be heartily commended, as well as the vigorous campaigns for the protection of present standing and growing trees from fire and insect pests.

### NET YIELD, LOG TO PRODUCT

There are, however, several branches of lumber conservation equally important with that mentioned above, i.e., more economical methods in the primary operation of converting the logs into boards, increasing the net usable material above the 50 per cent now realized; and more careful manufacturing processes in the secondary phases of making boards into furniture, pianos, vehicles, home equipment and the like, in which field the net finished product rarely represents more than 50 per cent of the board and often less. In other words, only about 25 per cent of the original tree (branches, trunk and root, bulk measure) emerges in final finished form.

The public are disposed to blame the lumberman and woodworker for exceedingly wasteful methods, and with some justice, without realizing that every industry is a development from primitive conditions, and that the real fault lies in the almost universal American habit of extraordinary prodigality of natural resources. The remedy for such wastefulness in wood utilization, as in other similar conditions, is to be found along the lines of a broader knowledge and understanding of the real facts by the American people. The woodworkers will lend their heartfelt co-operation, but cannot "mend the leak alone."

Let us, therefore, examine the present woodworking methods and try to discover some of the causes of the most flagrant waste, and make more clear, to ourselves at least, the ways leading to desirable and necessary waste reduction.

Wood will be used more intelligently when the law of supply and demand, improved scientific methods of manufacture, and public sentiment for conservation, openly unite in requiring its more economic utilization.

### SAW MILL WASTE

A brief description of the saw mill processes will indicate the magnitude of the problem there. When the timber is felled, roots, tops and branches of small trees are discarded or burned, partially recovered sometimes in the case of spruce for paper pulp, of some species of pine for destructive distillation into turpentine, rosin and naval stores and of some other woods for excelsior and charcoal. But, in the main, there is a wood waste of from 12 to 16 per cent that is not at present adapted to useful purposes. As the logs pass on to the saw table, the bark and slabs are added to the waste or by-product, but the most serious loss is the $\frac{1}{8}$ in. saw kerf allowance for band sawing (usually considered as $\frac{1}{4}$ in. on circular saws) and another $\frac{1}{8}$ in. allowance for shrinkage in drying. Under most manufacturing conditions $\frac{1}{4}$ in. vanishes entirely in sawdust and shrinkage. The majority of boards are sawn for 1 in. thickness, so this is at least a 15 to 20 per cent loss. The wood loss of from 12 to 16 per cent with the above sawdust and shrinkage loss of 15

to 20 per cent and the slab, trim and edging losses will aggregate conservatively 40 per cent for rough lumber. Timbers are seldom planed or dressed, but most form lumber for concrete work, all house trim, flooring and nearly all packing lumber is surfaced down to ¾ in. This will easily account for 10 per cent more waste.

No attempt is made for ultimate accuracy in summarizing these losses, as different species, varying manufacturing methods and the many ultimate uses preclude any degree of exactness. The general aggregate of 50 per cent, however, seems reasonably established, so far as the product of the log is concerned.

### FURNITURE MANUFACTURING METHODS

Let us turn to the problem of making furniture which may be considered typical for woodwork manufacturing. The rough hardwood lumber, representing not over 60 per cent of the original complete tree is delivered at the factory. At the cut off and rip saws the stock is reduced to desired lengths and widths, having knots, splits and defects cut out. It is rare to have a board cut into required lengths or widths without some waste. Allowance is still to be made for subsequent machining operations, such as trimming, jointing, surfacing, molding, etc. A yield of 70 per cent net usable lumber at saws is considered excellent, but is seldom attained. This lumber, cut to rough dimension size, is then machined in various ways, usually reduced from a thickness of 1 in. to ⅝ or ¾ in., glue-jointed, band sawed to irregular shapes and dressed smooth to permit finishing with varnish and polishing. The loss in thickness alone accounts for 20 per cent waste reducing our yield, from 70 to 55 per cent, without deducting other machining losses. A yield of 50 per cent from the board is therefore all that can be conservatively expected in these secondary woodwork operations.

Space will only permit three or four brief outlines of better productive methods, which should, at one and the same time, give more generous wood yield, lower manufacturing costs, and thus offer substantial money inducement to both employer and employee alike.

### LUMBER YIELD ON THE POINT SYSTEM

An ingenious and effective method of stimulating large yields from raw lumber is practiced by one of the large sash and door factories. Its production is sufficiently standardized so that pieces of wood of varying sizes and shapes each have their labor value expressed in points, and on the aggregate of these points the labor is paid and the efficiency ratio calculated.

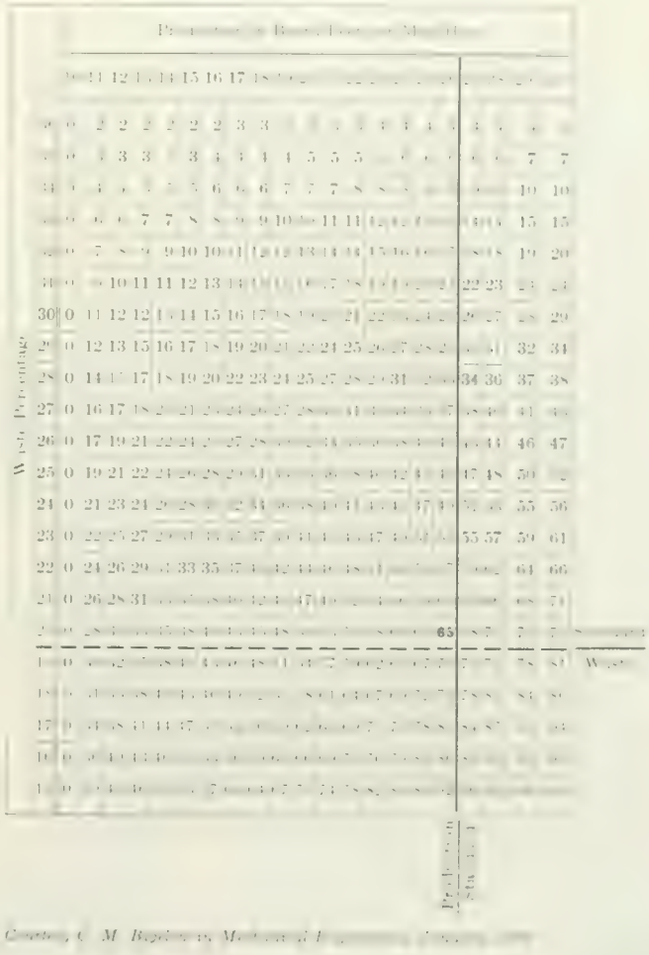
As an illustration of the "modus operandi" of this point system, a two panel door containing five pieces of lumber is apportioned points somewhat as follows:

| QUAN | PART | DIMENSIONS | AREA EACH | POINTS | POINTS PER SQ FT. AREA |
|---|---|---|---|---|---|
| 2 | Stiles | 6 ft. 8 in. x 6 in. | 3.66 sq. ft. | 91 | 25 |
| 2 | Rails | 1 ft. 8 in. x 6 in. | 0.75 sq. ft. | 10 | 13 |
| 1 | Rail | 1 ft. 8 in. x 2 [illegible] | [illegible] | 18 | 16 |
| | Cores | [illegible] | | | 5 |

Every sawyer will be mentally alert to scrutinize every board and ascertain how much can possibly be converted into pieces that bring a high return. Stiles yield nearly twice as much as rails per square foot and only the unavoidable small pieces go into core stock. In most lumber cutting mills the amount of short pieces overbalances the larger or longer, and a dearth of large pieces ensues. Sawyers have it within their power to convert lumber into desirable or undesirable pieces, and their importance as key men has been underestimated. Careless or underpaid sawyers cannot be expected to produce large yields.

The result at the above sash and door plant has been most gratifying: sawyers are cutting from 10,000 to 12,000 ft. per day (5000 to 7000 is normal); they are well paid and satisfied; and the net lumber yield is over 80 per cent (not considering losses in thickness),

TABLE 1. RATIO OF WASTE TO PRODUCTION IN BOARD-FEET PER MAN-HOUR



where from 60 to 70 per cent might be anticipated under ordinary conditions.

### WASTE REDUCTION INCENTIVE

Footage per man-hour is another way to increase productivity and ultimate yield, and is used in one of the larger factories producing office furniture. A chart showing a comprehensive range of waste and productivity was carefully determined and tabulated. (See Table 1.)

Eventual standards of 20 per cent waste and 26 bd. ft. per man-hour are indicated by extended lines and were considered reasonably attainable, although previous averages had been 45 per cent and 12 ft. respectively. The figure "65" in bold face type indicates an earned bonus of 65 per cent over base wage rates.

Over the first six months period the waste was reduced from 45 to 28 per cent and the yield increased from 12 to 21 ft., entitling the labor to a premium of 27 per cent. Using 50 cents wage rate and $70 lumber consumed at a daily average of 3333 ft. (1,000,000 ft. annually), would reduce the amount of raw lumber cut (for the same net yield of 550,000 ft.) from 1,000,000 to 764,000 ft.; and would show annual savings of:

| | |
|---|---|
| Labor saved | $7,640 |
| Labor eliminated (less cut) | 9,912 |
| Material saved (236 @ $70) | 16,520 |
| | $34,072 |

Obviously this is equivalent to a saving of approximately $3.50 per 1000 ft. on all lumber purchased.

When the 65 per cent bonus rate was achieved, some year or more later, the savings were materially increased.

### PURCHASING DIMENSION STOCK

When a board is sawn from the log to go into structural work, it is used in approximately its full size, and the downfall into short and narrow pieces is worth correspondingly less. This is true of most soft woods.

When a hardwood board is similarly produced for remanufacture into furniture, pianos and the like, it is cut down into smaller pieces, and the shorts and narrows should not be so heavily depreciated as in soft woods.

In this latter case, habit and tradition have established a practice on the part of wood workers of demanding the upper grades and declining the lower grades. The saw mill suffers a considerable loss from this discrimination, but the consuming public eventually pays—as it always does!

### THE ECONOMICAL METHOD

How much more reasonable and economical if the woodworker could be educated and persuaded to specify lumber, not in boards that are a purely artificial intermediate form, but in a reasonable assortment of sizes that could be dimensioned at the saw mill and thus secure the largest proportion of ultimate net product and a correspondingly less waste. Net yields would be materially increased, lower grades nearly eliminated (as most defects could be cut out in dimensioning smaller sizes, and much of slabs and edgings would prove usable), transportation costs saved and the standing timber of the forest conserved.

One of the larger and nationally known handle companies tested this carefully for a period of three years, taking ash squares as a basis:

| COSTS PER 1000 FT. | 1922 | 1923 | 1924 |
|---|---|---|---|
| Ash logs | $ 85.00 | $ 77.00 | $ 82.00 |
| Squares from logs | 100.00 | 94.07 | 97.78 |
| Ash lumber | 90.00 | 84.00 | 85.00 |
| Squares from lumber | 136.47 | 129.41 | 130.59 |

The savings in cutting direct from the log are obvious, and squares so produced cost only three-quarters as much as when cut from lumber. Drying green dimension in kilns presents some problem, but drying methods are rapidly improving and this offers no insurmountable difficulty.

Altering the lumber buying habits of woodworkers will be a slow and tedious process, but Secretary Hoover and the lumber producers are vigorously at work on the problem through the Central Committee on Lumber Standards, which has already achieved excellent results on the similar soft wood program.

Considerable public wonderment is expressed at the recent surrender of many makers of household furniture to the indictments of the attorney general's department. Obviously this is rather an expedient to avoid harassing and expensive litigation than an acknowledgment of guilt. Competition between woodworkers has always been keen, frequently intense and unscrupulous. Small units of woodworking factories have been easy to establish and no large fortunes have resulted from the manufacture of wood. Possibly the woodworker would have liked to do what he is accused of doing, but has been utterly unable to do, i.e., to combine with his co-manufacturers to keep prices from being squeezed down to unprofitable levels, and to maintain his business position.

### HIGH COST OF RETAIL SELLING

There is, however, another side to this picture that undoubtedly has exercised considerable influence, that of the cost of retail selling. Not many years ago furniture was kept in somewhat dingy warerooms, or grouped together indiscriminately in an overcrowded salesroom. Purchasers must of necessity have had some imagination and considerable hardihood against dirt and mis-arrangement.

Today milady, for it is she that does most of the furniture buying, and all honor to her skill and discrimination in making our homes livable and attractive, is greeted with furniture all set up, in beautiful surroundings, equipped with all the home furnishings, electric lighted, carpeted, curtained, decorated and the like. Pieces or suites may be sent up to her home on trial, returned or exchanged. Extended terms may be granted for payment. And the cost has been distributed over all of us. Is it any wonder that retail costs have advanced two, three and four fold? The question is whether we are really ready to pay our share of this super-efficient service.

In the last analysis, the public, in the aggregate, establishes the demand and pays the cost, but usually both are done without a full realization of probable eventualities.

# Reducing Lumber Handling Costs

## Straight-Line Production Methods in the New Planing Mill of the Southern Pacific Railroad

A NEW planing mill, 126 ft. wide and 360 ft. long, was recently completed at the Southern Pacific Shops, Sacramento, California. The accompanying photographs show how lumber handling and processing have been simplified in the new building.

In the old planing mill, one of the original shop buildings erected during early construction on the Central Pacific, long timbers, such as car sills, were hard to handle. The shop was laid out before modern production methods were developed and work had to be switched around considerably for different operations. In the new mill, work enters one end of the building and is not shunted out of a direct course, but goes straight through consecutive operations and is delivered ready for use at the other end of the building.

FIG. 1 TRACTOR AND TRAILERS LOADED WITH ROUGH LUMBER ON CROSS TRACK AT ENTRANCE END OF BUILDING

At each end of the mill, outside tracks run parallel to the width of the building. From these, at right angles, three lines of track run through the building and connect the two cross tracks at each end. Turntables in the cross tracks enable cars to be run off on any one of the three lines traversing the building.

Thus, one main line on the entrance side serves as the delivery point for all rough lumber. This lumber can be shunted off on any one of the three tracks leading into the building, according to the product into which it is to be made. No transfer of material is made within the building, as the layout of equipment was planned to make the machines along each track line a complete unit for finishing the product assigned to this line. Finished products, or lumber prepared for the use of other departments, leaves the opposite end of the building and, by means of turntables, is shunted to a common track leading to all parts of the shops where lumber may regularly be sent.

Fig. 1 shows how the rough lumber is delivered to the plant by means of tractors pushing the cars which operate over the tracks as above described. Fig. 2 shows two loads of lumber on one of the tracks leading into the building.

Fig. 3 shows two truck loads of finished lumber ready to leave the other end of the planing mill, through which it has progressed without being transferred from the line of machines adjacent to the track on which it came in.

Fig. 4 shows a line of machines, extending on both sides of a railroad track, from one end of the shop to the other, for performing successive operations on car sills. The rough timber is placed on the rollers in the foreground and then passes over the machine shown directly ahead at the right. Rollers extend from this machine to the next, over which the timbers are moved for the next process, and so on until the other end of the shop is reached. All lifting has been eliminated.

In Fig. 5 are shown the three tracks leading from the end of the shop where the finished material is

FIG. 2 ROUGH LUMBER ENTERING SHOP ON ONE OF THE THREE TRANSVERSE TRACKS

Exhaust fan and storage bin for shavings are shown at the left.

FIG. 3 FINISHED LUMBER READY TO LEAVE PLANING MILL FOR DEPARTMENT WHERE USED

stored until it is ready to be taken to the points where it is to be used. In the foreground of this picture is a load of freight car doors that have just been turned out in the planing mill.

There is a short extension to this track for delivering freight car doors to the paint-spraying platform shown in Fig. 6. Here the doors are unloaded from the trucks and set on end to be spray-painted by a compressed air nozzle as shown in the illustration.

The photographs also show the excellent lighting of the interior of the shop. Large monitors admit abundant daylight and afford means for natural ventilation. Almost the entire sides and ends of the building are of glass and hence the illumination is good at all points.

An ample electrical lighting system has been installed for night work. The location and distribution of the lamps are shown in Figs. 3 and 4.

A notable improvement over the old shop is that all machines are operated by individual motors instead of being driven from line shafting. This method has many advantages. Overhead shafting and belting are eliminated, giving better light, unobstructed vision and more room. Maintenance of such a complicated overhead system is avoided. Safety is materially increased, both from the elimination of oiling and repair work on moving transmissions, and because the operating hazards at machines are lessened. Power consumption is reduced because only the equipment in use is kept running, and not intermediate driving mechanisms which are also in train to run tools that are idle a good part of the time. Convenience of operation is also assured for the workmen.

FIG. 4 ROLLER FEED TABLES AND MACHINES FOR CAR SILLS

A complete exhaust system has also been installed. All sawdust and shavings are taken away from the machines and the floor by suction and without manual labor. In Figs. 1 and 2 are shown the exhaust equipment located outside of the building. Shavings and sawdust, after being drawn from the woodworking machines, are deposited in the large overhead storage bin. Later they are dumped into box cars for delivery to the power house for burning under boilers or to some other point where they are to be disposed of.

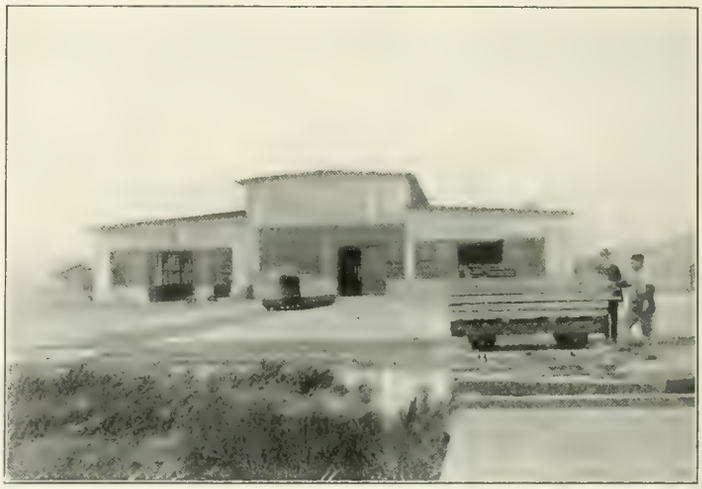


FIG. 5 FINISHED LUMBER COMES OUT AT THIS END OF THE PLANING MILL

Turntables shift it to the cross track for delivery to other departments of this woodworking plant.

FIG. 6 SPRAYING FREIGHT CAR DOOR

The removal of sawdust by suction not only saves hand labor and thereby cuts costs, but it also keeps dust out of the air of the shop and makes the building a much more healthful and agreeable place to work in.

# Judging Organization and Personnel

## In the Financial and Industrial Investigation

By ARTHUR ANDERSEN

*Arthur Andersen & Co.*

THE normal expectation of most businesses is growth. This growth is attained through greater sales, greater operations and utilization of greater capital. It is almost invariably accompanied by increased personnel, by a greater specialization or functionalization of each man's work and by increasing difficulties in the supervision of personnel and the direction of work.[1]

Very often the most critical time in the history of a business is when it reaches the point of being too large for one-man control and too small for effective functional organization control. At that time too little is known about the principles of organization, there is rarely a clean cut definition of authorities or assignment of responsibilities, and the personnel has not been trained to handle the broader scope of work thrust upon it. For a long time thereafter the effect of the one-man regime will be felt and in many businesses of the present day there exist organization and personnel problems arising from the retention of old and privileged employees, from the handling of certain detailed and minor functions by the executives, from a tendency to disregard organization lines and from overlapping functions.

The perfect organization is unattainable because theory must always be modified by particular and usually personal conditions, and also because the business itself is always growing or changing, necessitating a flexibility and adaptability in organization plan. Yet the matter of organization and personnel is so vital and so influences the effectiveness of management that it becomes one of the first and most important points of study in either the internal or external investigation.

### Broad Tests of Correct Organization

The best organization form is that which first recognizes a few basic principles and then is intimately adapted to the particular conditions of the given business. This adaptation may often at first glance make the organization plan appear faulty. Certain fundamentals are essential, however, and should be found in every sound plan of organization. Responsibilities and authorities must be clearly defined and must be equal. The organization plan should be functional rather than personal in character. It should be generally understood and definitely observed.

Since organization is the principal instrument of management, the correctness of organization and personnel may often be partially judged by the effectiveness of management. That is, the history of sales, history of earnings, and analysis of net worth, to a great extent, reflect the qualities of organization and personnel. If the accomplishment has been good, and there have been no abnormally favoring circumstances such as patent monopoly or distribution monopoly, it is fair to assume that the organization has been good.

This is the broadest kind of a test and is not entirely dependable. The only other broad test is that of *esprit d' corps*. This is an intangible thing but nevertheless very evident. If the workers as a whole appear satisfied and interested in their work, if labor troubles are rare, if there is an air of "being on the job," these are indicative of favorable executive organization and personnel.

Naturally, the form of organization and to some extent the choice of personnel is a reflection of the abilities, attitudes, characteristics and methods of the chief executive. A business has been described as the lengthened shadow of one man, and by studying the chief executive, or rather, the one person who is really vitalizing the business, a very fair conception may usually be gained of what to expect from the detailed analysis of the whole organization. Sometimes the characteristics of the organization are those of some dominant personality who has passed out of the picture, but whose policies still profoundly influence the business.

### Detailed Tests of Organization

The investigative analysis of organization is made along standardized lines and necessitates the use of organization charts. The first step is to secure from the principal executives their conception of the plan, gradually combining and co-ordinating these ideas, modifying them by observation until a true plan of the executive level may be charted. The same process is gone through in each of the main sections of the business—sales, accounting and manufacturing—and then in each of the sub-departments, resulting finally in the production of a reliable chart of the complete organization plan as it actually exists and operates.

The preparation of such a chart is more difficult than would be expected, for it is only rarely that the organization has previously been charted or defined,

[1] Former articles on The Financial and Industrial Investigation were published in December 1925, pp. 325-328, and January 1926, pp. 17-22

and usually any existent charts are incorrect. Moreover, organization plans are usually so vague that a different conception exists in the mind of every person. Sometimes there has been a conscious effort to *avoid* defining the organization plan, on the theory that a definition of authorities would lead to discord and jealousy. Sometimes this theory is followed to such an extent that no definite titles of position are used on the basis that it does no good to call a man "General Manager,"—that he should prove his authority by demonstrated ability. This is an extreme attitude, but one that has been found to exist.

Having prepared a complete chart of the organization as it exists at present, the next step is to subject this chart to an intensive analysis for the purpose of determining its principal points of strength and weakness. It must be studied to determine whether there is a fairly clear definition of functions or whether certain men are each charged with several working functions. It will also show whether the functionalization and centralization of authority and responsibility are laid out on a sound basis, whether certain executives carry too heavy a load, whether there is provision for carrying on the work in the event the "key" executives drop out, and whether there is tangible provision for the co-ordination of the various functions of the business as a whole.

Each of the foregoing considerations is vital to the proper organization of the business and merits thorough investigation. It will be found in many instances that certain survivals of the one-man business idea have seriously crippled the application of the theoretical organization plan. Certain men will be found actually responsible for a number of disrelated functions who have carried over these responsibilities from the old days when the business was so small that they could effectively perform these various functions. Other men will be found who are charged with certain definite duties under the company's theoretical plan of organization, but who actually do not possess the requisite authority nor shoulder the real responsibility. These men really perform the functions of clerks or assistants to the older men who have retained the real authority while surrendering certain of the titles.

### Organization Balance

Another angle of the investigation concerns itself with determining whether the organization is properly balanced. If certain executives are continuously swamped with work while others are normally carrying a light load it is a sign of weakness in the organization plan or in the executive personnel. Assuming that the fault is found to be entirely with the distribution and allocation of executive responsibilities, it is evident that steps should be taken, which without destroying a true functionalization of the administrative and executive work of the organization, will serve to equalize the load.

The investigator will frequently find that although the principal executive positions are being effectively filled by the present incumbents, no real attempt is being made to train understudies who can take hold and carry on when the older men let go. Death is no respecter of persons and old age is inevitable. Unless provision for these eventualities is made in advance, an organization may be dealt a staggering blow at the very time the fortunes of the business are at a critical stage and the very best the entire organization can give is hardly good enough.

The analysis of a company's chart of organization may disclose the fact that, although each department of the business is run efficiently there is no effective co-ordination of the various functions into one harmonious, unified organization. Misunderstandings and petty jealousies among the several department heads may be nullifying the otherwise excellent work of the executives to a serious degree. If a chronic situation of this kind is found to exist, the responsibility therefor must be laid at the door of the general manager of the company. It is his duty to see that every department head is imbued with a breadth of vision which enables him to look beyond the walls of his own department and to work whole-heartedly in the interests of the organization as a whole. In addition to this co-operation of purpose there must be an effective correlation of endeavor as well. Production should be kept within the limitations of probable demand; and sales campaigns, on the other hand, should take into consideration the maximum production possible with the present plant facilities and factory organization.

### Relations of Organization and Personnel

Although it is essential that there be a definite organization plan and that this plan should follow certain basic principles, it is nevertheless true that organization is only the means of making the best use of personnel, and that incompetent personnel will result in faulty management in spite of a very high development of organization. Nevertheless faults in organization often produce faults in management which are improperly ascribed to faults in personnel. In the broad sense, an organization is faulty unless it gives every man a chance to grow and holds out to him a logical reward of bettered position as he develops.

If the executives hold their position because of a family influence rather than because of ability, the ambitions of the sub-executive personnel will be stifled and really promising men will not remain long in an organization with that inherent handicap.

Similarly, if the higher executives do not deliberately try to develop the men under them by increasing delegations of responsibility and authority, these sub-heads will not develop fully of their own initiative.

If the management fails to analyze properly the requirements of various positions, or fails to analyze the characteristics of the various employees, it is

almost inevitable that some men will be misplaced, that is, required to do a type of work for which they do not have the training, experience, mentality, personality or inclination. Thus a man who might be excellent as a statistician would probably be a failure as a salesman. Possibly a competent salesman would be absolutely misplaced as sales manager. A good accounts-receivable clerk might fail as credit manager, or a shop superintendent fail as purchasing agent. It is not unusual to find men misplaced in the high executive levels, for men have been made general managers because of excellent showings as sales manager or comptroller; and men have been retained as works managers who should have been advanced to general manager. Not infrequently the influence of inherited stock interest has resulted in the filling of high executive places by incompetents.

The investigation of the executive personnel, therefore, is an essential corollary to the analysis of the organization plan. This investigation entails a study of the qualifications of each of the executives for the position he holds, with special consideration to the results he has accomplished.

### Functions of Committees

In making the investigation of organization it will usually be found that there are various committees or conferences, which are supposed to be made up of certain executives or department heads, and which are supposed to meet at fairly definite times for advisory or analytical purposes. In many cases however these committees have lapsed from their original intention. They either may not meet as arranged; or certain of the personnel are habitually absent; or their meetings may prove futile of constructive accomplishment. Cases have been noted where executive committees theoretically existed but actually had held no official meetings for years and kept no records whatever of such informal get-togethers as occurred.

For the purposes of the investigation it is essential that all existing committees and conferences be carefully identified and that any "theoretical" committees be studied as to their actuality and effectiveness. Furthermore, the organization plan must be studied to determine whether there is a lack of co-ordination which might be remedied by the creation of certain committees. If committees are recommended in the proposed organization plan, they must be fully specified as to personnel, time and frequency of meeting, purpose, functions of authority and responsibility, and relationship to principal executives.

If committees are worth having, it is worth while for them to keep full and accurate records of their meetings, in order that full value may be had from the subjects discussed and the suggestions and conclusions arrived at. It will be necessary that they have the power of appointing special sub-committees on problems requiring further investigation, study or assembly of data.

It sometimes happens that committees which were properly conceived and started have so changed their functions as to be actually a danger and detriment to the business. One example of this that comes to mind is that of an executive committee which gradually gained the ascendency over the chief executive, until it actually absorbed the executive function, yet because of discord between individuals was always failing to come to absolute decisions, each individual assuming the right to issue orders or make decisions on any matter. Such a situation is sometimes the result of a normally conceived advisory committee system, but in other cases it results from actually setting up a committee form of organization.

The committee form of organization is usually found to be dangerous, since most such committees waver between the extremes of gross assumption of authority by some members and a disclaiming of authority by all members. This results in preventing both workers and outsiders from securing either quick decisions or effective action on questions of policy. Fortunately this committee system of control is becoming rare, but where it is encountered in the course of an investigation it must be subjected to the most careful scrutiny for its manner of operation and its effect on the business as a whole.

If the business is of any size it will be found that almost inevitably committees are the chief vehicle for producing teamwork and co-ordination of viewpoint in the organization. The larger the business, the greater is the need for such definite co-ordination, because the number and the physical separation of executives prevents the opportunities for personal contact and understanding which occur in the smaller establishments.

Properly directed committees are indispensable to the conduct of modern business. They serve as advisory bodies to the higher executives, tend to create broader individual viewpoints, and promote harmony, unity, tolerance, and understanding among the entire personnel.

### Personal Statistics

Preliminary to the study of personnel qualifications there must be secured a list of the executive and administrative personnel, giving position, name, age, salary, years of experience in the business, and sometimes the stockholdings. This list is analyzed from the viewpoints of: age, how long the executives may expect to remain active in the business and whether the sub-executives are younger; salary, whether compensation is adequate for the position or excessive and whether cheap men are used in responsible positions; stockholdings or bonuses, to indicate whether remuneration is based on effort and whether a financial incentive exists. Various minor analyses and conclusions may be made from such a list, and sometimes it is desirable to carry a similar analysis down to and including the workers, showing classifications of skilled and unskilled, age and service by groups, rates of hourly pay, men on day or piece work, number on

pension list, and other equally significant groupings.

### PERSONNEL QUALIFICATIONS

Having secured the foregoing statistical data on the executive and administrative personnel, the next step is to size up the fitness of the individual for the executive position he occupies. The qualifications to be considered in such an analysis may be said to be comprised of the following:

| | |
|---|---|
| Character | Experience |
| Mental capacity | Personality |
| Judgment | Education |

The relative importance of these qualifications, of course, will vary with the position that the man occupies although it may be said that honesty and integrity of purpose are fundamental pre-requisites for every responsible executive position. Mental capacity is a qualification that is of immense importance where original thinking and constructive work are required, but which may be almost a handicap to the performance of monotonous and routine tasks for any extended period. Mental capacity often varies largely by inclination or tendency, in fact this may almost be said to be the rule of life. Certain men may have great abilities along the lines of mathematics who are duds when it comes to things mechanical. A great lawyer may possess an inherent inability to understand the elements of double entry bookkeeping. Similarly, a man may be so constituted that he can readily grasp sales principles, sales psychology and sales arguments and yet be hopelessly bewildered by problems of production planning or materials control. Experience and education represent acquired qualifications to a large extent although the benefit derived by a man from his training will be affected largely by his mental capacity. Judgment and personality, on the other hand, resemble mental capacity in being qualifications that are primarily inherent in the individual, although these qualifications also may undoubtedly be developed by intelligently directed effort.

### QUALIFICATIONS OF EDUCATION

In every position the matter of education must be given some weight. Thus a laborer in the yard gang needs so little that he may not be able to read or write, he need not even speak the language of the country. His educational requirements are practically zero. But unless he can read, write, speak the language and possibly have some knowledge of figures, he cannot normally hope to be made foreman. Generally, as the importance of the work increases, the educational requirement increases. This is true even aside from that class of work which is technical in character and is based on educational training or preparation. In the higher executive levels an education of a cultural type is a great advantage if not actually a necessity, since the position may carry with it distinct social obligations.

In analyzing the educational attainment of a person the mistake must not be made of gaging it by the extent of school, college or university contact. Many men are so absorptive that they acquire new elements each day from books, papers, or personal contact. Many others are so earnest in self-improvement that they are consciously and conscientiously increasing their education by means of night school, correspondence courses, or self-imposed routines of study. Nor must it be assumed that the more education a person has, the better he is fitted for his given job—rather, the job must be studied as to its educational requirements, then if the person measures up to these, that is all that is required.

### QUALIFICATIONS OF EXPERIENCE

Experience and education are in some ways closely related, for specialized education may be acquired by experience in the particular type of work. It is hard therefore to draw the line between the requirements of education and experience in many positions. This is particularly true where education has been of the job-preparatory or trade school type. For example, men may come from automobile trade schools and work satisfactorily side by side with mechanics of 20 years' experience. So the job must be carefully studied as to the extent to which greater or specialized education may be substituted for specialized experience, or *vice versa.*

In positions requiring supervisory capacity experience is vital. There is, to be sure, a question of aptitude, for some men have such attributes of personality that no amount of experience can make them capable of departmental supervision, and this fundamental handicap usually is so potent that it blocks the acquirement of experience.

Some experience is indirect, since every man handles some types of work for the first time. Yet his ability in the job may be increased by experience of a related or supplementary type. Thus experience as a stock clerk is an aid to handling a clerical job in the purchasing or production departments. Experience as sales manager is of value in taking on the duties of general manager. Even experience as a top sergeant in the army may be an asset in many factory supervisory positions.

It is practically axiomatic that a man's abilities in any position are increased by the extent of his experience in that or in closely similar positions. The extent of increase is however problematical. Thus of two men with equal years of experience, one may have so much greater mental capacity, or so much more energy, or ambition, that he has derived several times the benefit from that experience that the other has.

There is a theory that the difference between the average man and the notably successful man is only two per cent—of either ability, desire or energy. This is debatable. But it is the slightly greater "drive" of some men which causes them to derive more benefit from all experiences, acquire more education, make

greater use of their inherent abilities and become more out-standing in personality. It is intangible, but makes itself known in tangible results and therefore is always taken into consideration.

### PERSONNEL ANALYSIS

The problem of the investigator, therefore, becomes one of studying each one of the important members of the organization and of reaching a sound conclusion as to whether he is fit or unfit in the particular position occupied. Although the six qualifications mentioned above are important for every executive position, he will be governed in reaching his conclusions by the special requirements of the position under consideration. Thus the duties of general manager make such varied and exacting calls upon a man that the successful general manager must, as a rule, possess the first five qualifications, and preferably the sixth also, in a marked degree in order to measure up to the demands of his position. The prime essentials for the successful sales manager may be said to be personality or wide acquaintance with the trade, which is just a form of experience, and that combination of mental capacity and judgment which enables him to plan his campaigns with resourcefulness and daring while seasoning them with the essential modicum of common sense. The accountant must be a model of conscientiousness and business integrity while possessing sufficient technical knowledge of his work to enable him to make a true record of the company's financial transactions.

The foregoing cases are used only as illustrative of the varying standards the investigator will use in striving to determine the fitness of the individual for the position he occupies. In the course of his investigation he may find several executives who appear to fall far short of his minimum requirements. If engaged in a financial investigation for a security issue he may probably stop at this point, but if engaged on an internal investigation for the management, he will attempt to find the underlying reasons for the short-comings in order that he may be in a position to make constructive recommendations.

Certain of these men who fail to make the grade will be found to be individuals who owed their positions in the first place to family connections or other influence rather than to any demonstrated capacity for the work. Other men will have succeeded to their positions, under the rule of seniority, through years of loyal and painstaking effort. Unfortunately, not every faithful employee, who has grown old in the company's employ is fitted for an important position and the promotion which was intended as a reward for years of loyal service may have spoiled a perfectly good shop foreman in the making of an incompetent shop superintendent. Still other men will be found to possess real capacity and valuable preliminary training whose failure to meet the requirements of their positions is due to the fact that, fundamentally, they are better adapted for other work.

Having reached his conclusions in each case as to the underlying causes for the failures and short-comings among the personnel, the investigator will bring his recommendations as tactfully as possible to the attention of the men who have ordered the investigation. In making these recommendations the greatest care must be exercised to avoid all pretensions to omniscience or infallibility, for it goes without saying that it is impossible for any man to step in and, in the course of a relatively limited investigation, diagnose accurately and effectively prescribe for all of the organization problems of a large corporation. On the other hand, there is no discounting the value of an outside viewpoint especially when it represents the viewpoint of an investigator trained in the study and solution of problems of just this type.

### VITAL IMPORTANCE OF PERSONNEL

With the industrial activities of our present day ever broadening and ever assuming larger and more complex structures it is inevitable that problems of organization and personnel will more and more become of vital importance in determining the fortunes and indeed the continuing existence of any business enterprise. The days of profit margins sufficiently wide to absorb the mistakes of faulty management are rapidly drawing to a close. In fact, we already see many of the key industries of this country in the hands of a relatively small number of large and highly developed units which have achieved their strong position in their respective fields only through having developed a highly organized and supremely effective type of management.

To the solution of these broader questions involving corporate success or failure the investigator of organization and personnel problems should be prepared to make a real contribution.

Thus we see how in modern business, correct organization and capable personnel go hand in hand as essential factors to success. The investigator who delves into these problems, who attempts to place his finger upon the weak spots in the plan of organization or among the executive personnel and who undertakes to make recommendations looking to their cure, is charged with a most serious responsibility to sift and weigh the evidence until he is certain of his conclusions. Let him but sense the extent of this obligation and the weight of his responsibility, and then his opportunities for constructive service will be commensurate with the responsibilities he assumes.

[The March instalment of Mr. Andersen's group of articles on the financial and industrial investigation will take up the investigative analysis of net worth. It is recognized that a careful analysis of the net worth of a business will often develop many facts bearing upon the financial policies which will be adopted and put into effect by the management. Mr. Andersen shows how to develop these facts and bring to bear upon their analysis other factors than those which are merely presented by figures.—The Editors.]

# Accounting for Values or Dollars

By JOSEPH F. DILLMAN

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AN article by Stephen McKenzie DuBrul in the December issue of this journal condemns the attitude of accountants because of their contention that depreciation should be calculated and charged off and that reserves should be created on the basis of *cost* values of fixed assets. Mr. DuBrul's contention is that the amount of depreciation should be determined on the basis of *replacement* values.

If there is any room for dispute on this point, it can only be because of differences of opinion as to what is meant by the term "depreciation." An accountant would define depreciation as "the extent to which the values of assets, based on their cost, have decreased as a result of time, or use of the assets, or both (ignoring residual values.)" Or, "that portion of the cost of an asset which is represented by an amount equivalent to the same ratio of the cost of the asset as its expired or consumed portion of usefulness bears, to its total usefulness." The word *cost* in each definition is necessary.

## Effect of Theory Advocated

Following out the theory advocated by Mr. DuBrul, all assets, fixed, current and others would have to be carried at estimated cost of replacement in order to account for values instead of dollars. The effect of this would be eventually to increase the net worth to the same extent as net worth would be reduced by the additional depreciation charge and other charges when assets were consumed. Furthermore, a concern renting store space would have to increase its liability for rent each month and charge a larger amount to rent expense than it actually paid in case a favorable lease had been made when the purchasing power of a dollar was greater. Liabilities for salaries and other services purchased would also have to be increased in case such values as they provide could not be acquired at the present time except for more dollars than it was necessary to pay because of union contracts or for other reasons.

There is no objection on the part of accountants (whether they be ordinary or of the "scientific" variety referred to by Mr. DuBrul) to limiting the amount of dividends to be paid to stockholders so as to make certain that there will be sufficient funds available to purchase new fixed assets when those which are depreciating have served their useful life. Under ordinary conditions such would be the effect of creating reserves for depreciation on the basis of replacement values. Accountants, scientific or otherwise, would recommend such a procedure unless there were other reasons for not doing so, but why call the excess amount "Reserve for Depreciation." To say that an asset which cost $10,000 has depreciated $15,000 in value is not a true statement and, therefore, no accountant should assert it.

## Accounting Is Concerned with Facts

An accountant is concerned only with facts as they are. He is not a prophet or clairvoyant. Lawyers, engineers, bankers or business men may take upon themselves that special function but they have no more right to do so than has an accountant. As a matter of fact even though an accountant were gifted with supernatural power which enabled him definitely and accurately to foresee the future, it would not change his attitude in the matter under discussion. He would still advocate charging depreciation expense and reducing fixed assets through the medium of Reserve for Depreciation accounts on the basis of the cost of such assets. His advice as to the amount of profits which should be distributed as dividends would depend upon what his powers as a seer informed him of as to the future. Or, if he had no such powers then his advice would be based upon his own conclusions arrived at through natural processes of reasoning, or perhaps upon the conclusions of others, whose judgment he would be willing to accept.

The income tax laws have no bearing on the question whatever and, therefore, two sets of accounts, as suggested by Mr. DuBrul, would be unnecessary for tax purposes. In so far as income tax laws are concerned a company can retain a portion or all of its profits in the business if it cares to do so, whether the object be to make unnecessary the contribution of additional capital for the purchase of fixed assets, or for other reasons. There is no objection on the part of the Treasury Department and none on the part of accountants to having the board of directors of a corporation appropriate a portion of their surplus for a specific purpose, which amount could be expressed on the books of account by crediting the sum to "reserve for excess of replacement over cost value of fixed assets," or whatever other name might seem more appropriate. A similar amount might also be deducted from the net profit representing the decrease in purchasing power of dollars of profit, as compared with a similar number of dollars in 1914 or whatever year is used as a basis, or it might even be possible to calculate it on the basis of amounts and times capital has been contributed since the inception of the business.

The fallacy of such a plan or of any plan of charging depreciation expense or any expense with an amount in excess of cost can be pointed out in other ways.

# Cutting Labor Costs 37 Per Cent

## Results of Bonus in Car Loading

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IT sometimes happens that the idea of a bonus for certain operations is discarded because of the number of variables involved, which apparently make the idea seem impracticable. This article deals with the method by means of which a comparatively simple bonus was evolved on an operation of this kind.

In the plant of a large mid-western concern manufacturing a wide variety of bulky products, 66 in number, the problem of loading box cars was one of constant irritation. Thirty-six men were employed on this work which was heavy and laborious, and the wages paid were those paid to ordinary laborers in the vicinity. An average of 18 box cars were loaded per day. The equipment available was not the best for the purpose, but no money was available to better these conditions. The men were never happy on their jobs and consequently the labor turnover was high, necessitating an exorbitant amount of attention on the part of the plant executives. Overtime work was almost a chronic daily occurrence, for which time and a half was paid.

TABLE 1. DIMENSIONS OF PACKAGES

The first letter of the symbol denotes a package, the second letter the brand, and the third letter the color. R = Red, G = Green, B = Black

| Product | Weight of one Pounds | Dimensions Inches | Number per truck | Minutes to | |
|---|---|---|---|---|---|
| | | | | Load one | Stow one |
| P S R | 59 | 8 x 12¼ | 40 | 0.13 | 0.10 |
| P S G | 59 | 8 x 12¼ | 40 | 0.13 | 0.10 |
| P S B | 59 | 8 x 12¼ | 40 | 0.13 | 0.10 |
| P G R | 65 | 8 x 12¾ | 40 | 0.13 | 0.10 |
| P G G | 65 | 8 x 12¾ | 40 | 0.13 | 0.10 |
| P G B | 65 | 8 x 12¾ | 40 | 0.13 | 0.10 |
| P M R | 95 | 10 x 32 | 20 | 0.17 | 0.11 |
| P M G | 95 | 10 x 32 | 20 | 0.17 | 0.11 |
| P M B | 95 | 10 x 32 | 20 | 0.17 | 0.11 |
| P T R | 79 | 12½ x 32 | 20 | 0.14 | 0.10 |
| P T G | 79 | 12½ x 32 | 20 | 0.14 | 0.10 |
| P T B | 79 | 12½ x 32 | 20 | 0.14 | 0.10 |
| P O R | 95 | 11 x 34¾ | 20 | 0.17 | 0.12 |
| P O G | 95 | 11 x 34¾ | 20 | 0.17 | 0.12 |
| P O B | 95 | 11 x 34¾ | 20 | 0.17 | 0.12 |

The method used to load the cars was as follows. The shipping foreman divided his 36 men into loading crews of varying numbers. In each crew there was a "checker" who acted as gang boss. Shipping orders were issued to the checker who instructed his men as to what products were required, checked the number of packages brought, and weighed them. As the packages were heavy and bulky two men were assigned to one truck. These two men would take their truck to the proper bin in the warehouse, load it, push it to the scales where the checker weighed the load, then pushed it into the box car and waited for the "stower" to unload it. They then took the empty truck back for the next load that the checker called for.

The products were of two general types, rolls and flat packages. The rolls, 51 kinds in number, varied in diameter from six inches to 13 inches, and in weight from 20 to 95 pounds. The majority of these rolls were required to be stood on end while a few were laid on their side. The flat packages, 15 varieties in number, varied in size from 12 in. by 16 in. to 10 in.

TABLE 2. DIMENSIONS OF ROLLS

The first letter of the symbol denotes a roll, the second letter the brand, and the third letter the color. R = Red, G = Green, B = Black

| Product | Weight of one Pounds | Dimensions Inches | | How packed | Number per truck | Minutes to | |
|---|---|---|---|---|---|---|---|
| | | Diameter | Length | | | Load one | Stow one |
| R M R | 85 | 10 | 36 | On end | 21 | 0.10 | 0.06 |
| R M G | 85 | 10 | 36 | " " | 21 | 0.10 | 0.06 |
| R M B | 85 | 10 | 36 | " " | 21 | 0.10 | 0.06 |
| R V M R | 77 | 8½ | 36 | " " | 30 | 0.08 | 0.05 |
| R V M G | 77 | 8½ | 36 | " " | 30 | 0.08 | 0.05 |
| R V M B | 77 | 8½ | 36 | " " | 30 | 0.08 | 0.05 |
| R H R | 90 | 11 | 36 | " " | 21 | 0.10 | 0.06 |
| R H G | 90 | 11 | 36 | " " | 21 | 0.10 | 0.06 |
| R V R | 90 | 11 | 36 | " " | 21 | 0.10 | 0.06 |
| R V G | 90 | 11 | 36 | " " | 21 | 0.10 | 0.06 |
| R S R | 54 | 10 | 32 | " " | 21 | 0.10 | 0.06 |
| R S G | 54 | 10 | 32 | " " | 21 | 0.10 | 0.06 |

by 32 in., and in weight from 59 to 95 pounds each.

The various products were stored in bins in a warehouse approximately 500 feet long by 400 feet wide. A double spur track extended along the length of the building. Six shipping doors opened on to this platform. Each track had a capacity of 12 box cars. The cars were so spotted that the doors of the cars on the two tracks were directly opposite one another. By laying a bridge between the two, the car on the outside track was accessible from the platform through the near car. By this arrangement each of the six doors had four cars within a few feet of it.

The warehouse bins were used as available for storing the various products so that at different times any one of the 66 products might be found in any one of the 103 bins. A rather exhaustive study was made to see whether or not certain products could not be assigned to certain bins or to certain zones of bins but this idea had to be given up for several good and sufficient reasons.

The only solution to this situation seemed to be to provide a separate task for each of the 66 products in each of the 103 bins to each of the six doors. This gives a total of 40,788 combinations which would, of course, be entirely too cumbersome to handle in daily work and would be a possible source of errors in calculating the daily tasks.

With this in mind a study was started with the view of classifying the various products under a few heads and at the same time another study was begun to determine of what number and distribution of men the most economical loading crew could be composed. These two studies required that accurate time studies be made on the loading, trucking and unloading of each product. It was found that although the truck held a greater number of the smaller packages than of the large ones, the truckloads of all the products were approximately of uniform weight so that the trucking time per foot or per hundred feet was a constant quantity. In accompanying tables are given the data as to the physical characteristics of the various products. The figures in the last two columns were obtained from time studies. (See Tables 1, 2 and 3.)

After obtaining these data we were able to establish eight classes into which all the products were divided. These classes are listed as shown in Table 4.

TABLE 4. CLASSIFICATION OF PRODUCTS

| Class | Product | Number per Truck | Minutes to Load One | Minutes to Stow One |
|---|---|---|---|---|
| 1 | RYS | 75 | 0.07 | 0.04 |
| | RJ | 65 | 0.07 | 0.04 |
| | RA | 65 | 0.07 | 0.04 |
| | RXL | 75 | 0.07 | 0.04 |
| | RXLM | 65 | 0.07 | 0.04 |
| | RXM | 60 | 0.07 | 0.04 |
| | RQS | 60 | 0.07 | 0.04 |
| 2 | RYB | 55 | 0.08 | 0.05 |
| | RPL | 50 | 0.07 | 0.04 |
| | RTL | 50 | 0.07 | 0.04 |
| | RIL | 50 | 0.07 | 0.04 |
| | RXH | 50 | 0.08 | 0.05 |
| | RKS | 50 | 0.07 | 0.04 |
| | REL | 50 | 0.07 | 0.04 |
| 3 | REM | 40 | 0.08 | 0.05 |
| | RPM | 40 | 0.08 | 0.05 |
| | RTM | 40 | 0.08 | 0.05 |
| | RIM | 40 | 0.08 | 0.05 |
| | RFH | 40 | 0.08 | 0.04 |
| | RZL | 40 | 0.08 | 0.04 |
| | RQB | 45 | 0.08 | 0.05 |
| 4 | REH | 30 | 0.08 | 0.05 |
| | RPH | 30 | 0.08 | 0.05 |
| | RTH | 30 | 0.08 | 0.05 |
| | RIH | 30 | 0.08 | 0.05 |
| | RF | 32 | 0.08 | 0.05 |
| | RZH | 30 | 0.08 | 0.05 |
| | RU | 30 | 0.08 | 0.05 |
| | RKB | 30 | 0.08 | 0.05 |
| | RO | 30 | 0.08 | 0.05 |
| | RVMR | 30 | 0.08 | 0.05 |
| | RVMG | 30 | 0.08 | 0.05 |
| | RVMB | 30 | 0.08 | 0.05 |
| 5 | RL | 24 | 0.10 | 0.06 |
| | RW | 24 | 0.10 | 0.06 |
| | RC | 20 | 0.10 | 0.06 |
| | RGL | 20 | 0.10 | 0.06 |
| | RMR | 20 | 0.10 | 0.06 |
| | RMG | 20 | 0.10 | 0.06 |
| | RMB | 20 | 0.10 | 0.06 |
| | RSR | 21 | 0.10 | 0.06 |
| | RSG | 21 | 0.10 | 0.06 |
| | RHR | 21 | 0.10 | 0.06 |
| | RHG | 21 | 0.10 | 0.06 |
| | RVR | 21 | 0.10 | 0.06 |
| | RVG | 21 | 0.10 | 0.06 |
| | RGH | 15 | 0.10 | 0.08 |
| | RN | 20 | 0.10 | 0.06 |
| | RD | 20 | 0.10 | 0.06 |
| | RR | 20 | 0.10 | 0.06 |
| 6 | PSR | 40 | 0.13 | 0.10 |
| | PSG | 40 | 0.13 | 0.10 |
| | PSB | 40 | 0.13 | 0.10 |
| | PGR | 40 | 0.13 | 0.10 |
| | PGG | 40 | 0.13 | 0.10 |
| | PGB | 40 | 0.13 | 0.10 |
| 7 | PMR | 20 | 0.17 | 0.11 |
| | PMG | 20 | 0.17 | 0.11 |
| | PMB | 20 | 0.17 | 0.11 |
| | POR | 20 | 0.17 | 0.12 |
| | POG | 20 | 0.17 | 0.12 |
| | POB | 20 | 0.17 | 0.12 |
| 8 | PTR | 20 | 0.14 | 0.10 |
| | PTG | 20 | 0.14 | 0.10 |
| | PTB | 20 | 0.14 | 0.10 |

Summarizing these data we have eight classes to deal with instead of 66 products:

| *Class* | *Number Pieces Per Truck* | *Minutes to Place One On Truck* | *Minutes to Stow One In Car* |
|---|---|---|---|
| 1 | 60 | .07 | .04 |
| 2 | 50 | .07 | .04 |
| 3 | 40 | .08 | .05 |
| 4 | 30 | .08 | .05 |
| 5 | 21 | .10 | .06 |
| 6 | 40 | .13 | .10 |
| 7 | 20 | .17 | .12 |
| 8 | 20 | .14 | .10 |

As all products are loaded into the cars from any one of the 103 bins through any one of the six doors the trucking time from each bin to each door had to be found. As the trucking time is directly proportional to the distance trucked the distances from each bin to each of the doors was obtained and the time required was arrived at by multiplying the distance by the time required per foot as obtained by accurate time studies made with empty trucks and with full trucks.

The distances from bins to doors were divided into 22 classes as follows:

| *Class* | *Feet* | *Class* | *Feet* | *Class* | *Feet* | *Class* | *Feet* |
|---|---|---|---|---|---|---|---|
| 1 | 30 | 7 | 125 | 13 | 230 | 18 | 390 |
| 2 | 45 | 8 | 140 | 14 | 250 | 19 | 415 |
| 3 | 65 | 9 | 155 | 15 | 300 | 20 | 465 |
| 4 | 80 | 10 | 180 | 16 | 330 | 21 | 500 |
| 5 | 95 | 11 | 200 | 17 | 360 | 22 | 520 |
| 6 | 110 | 12 | 215 | | | | |

The distances shown in these classes are those into which the greatest number fell. Those distances from a bin to a given door which came between any two

TABLE 3. DIMENSIONS OF ROLLS

The first letter of the symbol denotes a roll, the second letter the brand, and the third letter the weight. L = Light, M = Medium, H = Heavy, B = Big, S = Small.

| Product | Weight of one Pounds | Dimensions Inches Diameter | Dimensions Inches Length | How packed | Number per truck | Minutes to Load one | Minutes to Stow one |
|---|---|---|---|---|---|---|---|
| R E L | 35 | 7¼ | 36 | On end | 50 | 0.07 | 0.04 |
| R E M | 45 | 8 | 36 | " " | 40 | 0.08 | 0.05 |
| R E H | 55 | 8¾ | 36 | " " | 30 | 0.08 | 0.05 |
| R I L | 35 | 7 | 36 | " " | 50 | 0.07 | 0.04 |
| R I M | 45 | 7¾ | 36 | " " | 40 | 0.08 | 0.05 |
| R I H | 55 | 8¾ | 36 | " " | 30 | 0.08 | 0.05 |
| R P L | 35 | 7 | 36 | " " | 50 | 0.07 | 0.04 |
| R P M | 45 | 7¾ | 36 | " " | 40 | 0.08 | 0.05 |
| R P H | 55 | 8½ | 36 | " " | 30 | 0.08 | 0.05 |
| R T L | 35 | 6¾ | 36 | " " | 50 | 0.07 | 0.04 |
| R T M | 45 | 7½ | 36 | " " | 40 | 0.08 | 0.05 |
| R T H | 55 | 8 | 36 | " " | 30 | 0.08 | 0.05 |
| R L | 63 | 10½ | 36 | " " | 24 | 0.10 | 0.06 |
| R W | 64 | 10 | 36 | " " | 24 | 0.10 | 0.06 |
| R C | 65 | 9¼ | 32 | On side | 20 | 0.10 | 0.06 |
| R B | 65 | 9 | 32 | " " | 20 | 0.10 | 0.06 |
| R D | 55 | 9 | 32 | " " | 20 | 0.10 | 0.06 |
| R O | 54 | 9 | 36 | " " | 30 | 0.08 | 0.05 |
| R Y B | 42 | 7½ | 36 | " " | 55 | 0.08 | 0.05 |
| R Y S | 21 | 7 | 36 | " " | 75 | 0.07 | 0.04 |
| R A | 30 | 6½ | 36 | " " | 65 | 0.07 | 0.04 |
| R R | 64 | 10 | 36 | On end | 20 | 0.10 | 0.06 |
| R N | 65 | 10¼ | 32 | " " | 21 | 0.10 | 0.06 |
| R F | 55 | 9¾ | 32 | " " | 32 | 0.08 | 0.05 |
| R F H | 32 | 8 | 32 | " " | 40 | 0.08 | 0.04 |
| R Z L | 32 | 8 | 32 | " " | 40 | 0.08 | 0.04 |
| R Z H | 43 | 9 | 32 | " " | 30 | 0.08 | 0.05 |
| R U | 64 | 8½ | 36 | " " | 30 | 0.08 | 0.05 |
| R J | 30 | 6½ | 36 | On side | 65 | 0.07 | 0.04 |
| R K S | 23 | 7¼ | 36 | On end | 50 | 0.07 | 0.04 |
| R K B | 45 | 9 | 36 | " " | 30 | 0.08 | 0.05 |
| R X L | 20 | 6¼ | 36 | On side | 75 | 0.07 | 0.05 |
| R X L M | 25 | 7½ | 36 | " " | 65 | 0.07 | 0.04 |
| R X M | 30 | 8 | 36 | " " | 60 | 0.07 | 0.04 |
| R X H | 40 | 9 | 36 | " " | 50 | 0.07 | 0.05 |
| R G L | 50 | 11½ | 36 | " " | 20 | 0.10 | 0.06 |
| R G H | 75 | 13½ | 36 | " " | 15 | 0.10 | 0.08 |
| R Q S | 30 | 8 | 36 | " " | 60 | 0.07 | 0.04 |
| R Q B | 60 | 9 | 36 | " " | 45 | 0.08 | 0.05 |

TIME ALLOWANCES FOR SHIPPING IN HOURS PER 100 PIECES

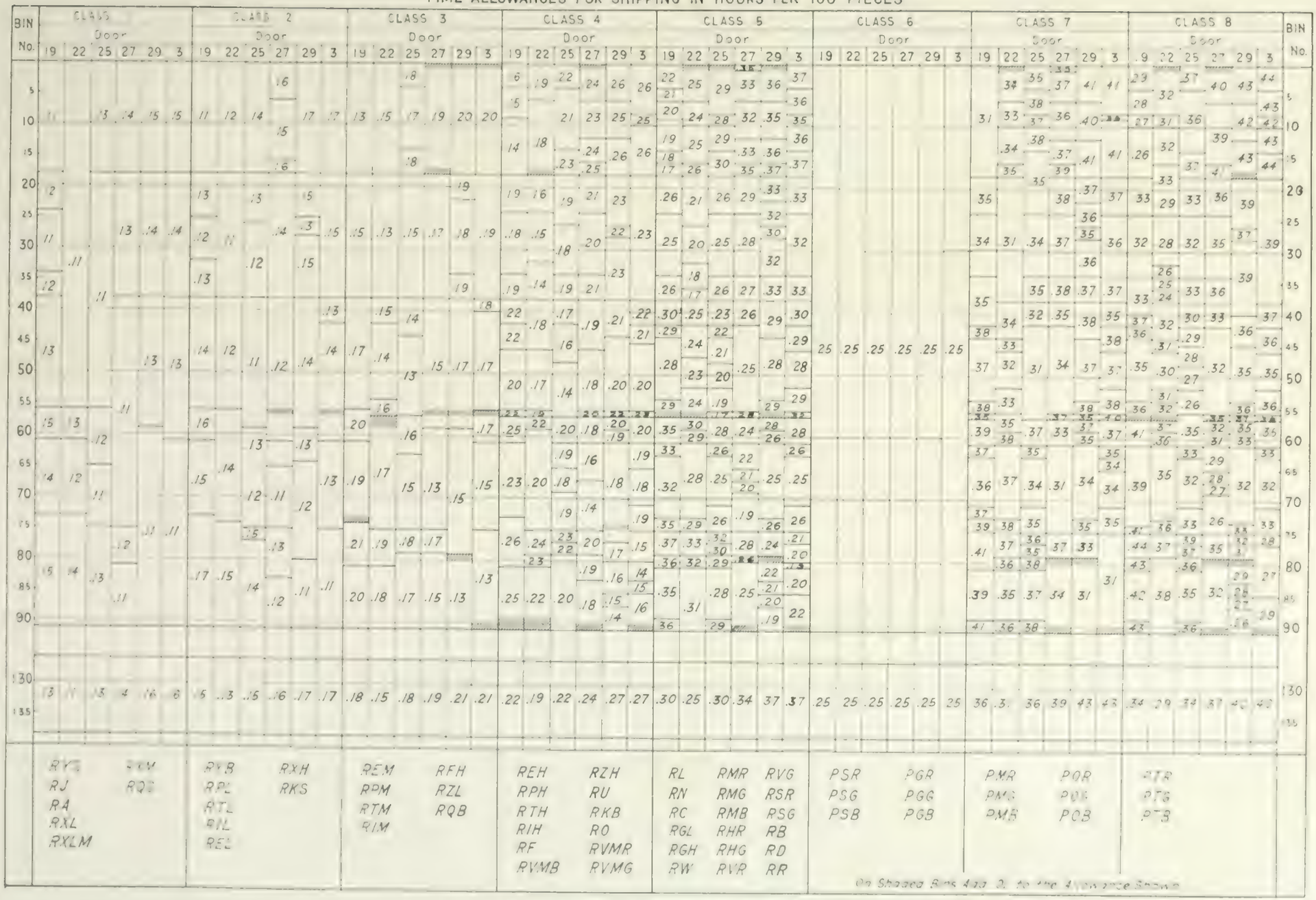


Fig. 1 Time Allowances for Shipping in Hours Per 100 Pieces

of these classes were thrown into the higher of the two. This had the effect in a few instances of slightly liberalizing the time allowed for trucking.

The details of the times required to move a truck to a bin, load it, push it to the scale, weigh it, move it into the car, into position and stow it were obtained by many careful studies on a number of good operators. The times for these elements shown below are the times actually needed and have no allowance for rest or delay. Allowance to cover rest and delay is made later in our calculations.

| | | *Minutes* |
|---|---|---|
| A | Push empty truck into bin and make ready to load. | .35 |
| B | Put side rods up on truck when loaded. | .12 |
| C | Move truck to entrance to bin. | .11 |
| D | Slow down truck approaching scale. | .11 |
| E | Weigh truck on scale. | .24 |
| F | Move truck from scale. | .11 |
| G | Push truck from platform into car into position. | .31 |
| H | Push loaded truck from scale to car door. | .20 |
| J | Push empty truck from car to scale. | .16 |
| L | Push loaded truck one foot on concrete floor. | .0041 |
| M | Push empty truck one foot on concrete floor. | .0035 |
| N | Number of pieces per truck load (see classification) | |
| P | Time required to load one piece on truck (see classification) | |
| R | Move empty truck out of car to platform. | .21 |
| S | Time required to stow one piece in car (see classification) | |
| U | Let bar down on side of truck. | .06 |
| Z | Distance from bin to door (see classification) | |

A general formula for the time required per piece to load a truck at any bin with any product by a truck crew of two men is

$$t = \frac{A + B + C + D + E + F + G + H + J}{N} + \frac{P}{Z} + \frac{(Z - 15)(L + M)}{N}$$

Substituting values for symbols where possible this equation reduces to

$$t = \frac{1.71 + 0.5PN + 0.0076(Z - 15)}{N}$$

Then the time per 100 pieces using 2 trucks will be

$$t = \frac{85.5 + 25PN + 38(Z - 15)}{N}$$

Adding 25 per cent to this for rest and delay and reducing to hours we have for the time allowance per 100 pieces

$$T = \frac{1.781 + 0.62PN + 0.0079(Z - 15)}{N}$$

In cases where the bins are located on the second floor there must be added allowance to cover the use of the elevator. This time with 25 per cent added for rest and delay is 1.15 minutes per truckload. The time per 100 pieces is $\frac{115}{N}$ minutes or $\frac{1.916}{N}$ hours. With two trucks in the crew this time would be $\frac{0.958}{N}$ hours. The formula for goods stored on the second floor becomes

$$T = \frac{2.739 + 0.62PN + 0.0079(Z - 15)}{N}$$

The time needed to stow one piece in the car is expressed by the formula

TABLE 5. FORMULAS FOR LOADING AND TRUCKING TIMES

Time allowance is in hours per 100 pieces

| Class | Bins on first floor | Bins on second floor | Stowing |
|---|---|---|---|
| 1 | .073–.00013 (Z–15) | .089–.00013 (Z–15) | .0927 |
| 2 | .079–.00015 (Z–15) | .098–.00015 (Z–15) | .0946 |
| 3 | .094–.00019 (Z–15) | .118–.00019 (Z–15) | .1182 |
| 4 | .109–.00026 (Z–15) | .141–.00026 (Z–15) | .1249 |
| 5 | .147–.00037 (Z–15) | .192–.00037 (Z–15) | .1517 |
| 6 | .125–.00019 (Z–15) | .149–.00019 (Z–15) | .2219 |
| 7 | .194–.00036 (Z–15) | .242–.00036 (Z–15) | .2780 |
| 8 | .176–.00036 (Z–15) | .224–.00036 (Z–15) | .2364 |

TABLE 6. TIME ALLOWANCES FOR FIRST FLOOR BINS

| Class | Distance in feet -bin to door | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | 45 | 65 | 80 | 95 | 110 | 125 | 140 | 155 | 180 | 200 |
| 1 | .075 | .077 | .080 | .081 | .083 | .085 | .087 | .089 | .091 | .094 | .097 |
| 2 | .081 | .084 | .087 | .089 | .091 | .093 | .096 | .098 | .100 | .104 | .107 |
| 3 | .097 | .100 | .104 | .106 | .109 | .112 | .115 | .118 | .121 | .125 | .129 |
| 4 | .113 | .117 | .122 | .126 | .130 | .134 | .138 | .142 | .145 | .152 | .157 |
| 5 | .153 | .158 | .166 | .171 | .177 | .182 | .188 | .193 | .199 | .208 | .215 |
| 6 | .128 | .131 | .135 | .137 | .140 | .143 | .146 | .149 | .152 | .156 | .160 |
| 7 | .199 | .205 | .212 | .217 | .223 | .228 | .235 | .239 | .244 | .253 | .261 |
| 8 | .181 | .197 | .194 | .199 | .205 | .210 | .216 | .221 | .226 | .235 | .243 |

| Class | Distance in feet—bin to door | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 215 | 230 | 250 | 300 | 330 | 360 | 390 | 415 | 465 | 500 | 520 |
| 1 | .099 | .101 | .104 | .110 | .114 | .118 | .122 | .125 | .132 | .136 | .139 |
| 2 | .109 | .111 | .114 | .122 | .126 | .131 | .135 | .139 | .147 | .152 | .155 |
| 3 | .132 | .135 | .139 | .148 | .154 | .160 | .165 | .170 | .180 | .186 | .190 |
| 4 | .161 | .165 | .170 | .183 | .191 | .199 | .207 | .213 | .226 | .235 | .240 |
| 5 | .221 | .227 | .234 | .252 | .264 | .275 | .286 | .295 | .314 | .326 | .334 |
| 6 | .163 | .166 | .170 | .179 | .185 | .191 | .196 | .201 | .211 | .217 | .220 |
| 7 | .266 | .271 | .279 | .297 | .307 | .318 | .329 | .338 | .356 | .369 | .376 |
| 8 | .248 | .253 | .261 | .279 | .289 | .300 | .311 | .320 | .338 | .351 | .358 |

$$t = \frac{NS + R + U}{N} = \frac{NS + 0.27}{N}$$

From this we get the time per 100 pieces, allowing 25 per cent for rest and delay.

$$T_2 = \frac{2.083NS + 0.5625}{N}$$

Substituting values for P and N for each class in formulas for first and second floors and values of N and S in the stowing formula for each class we have 16 general formulas having but one unknown quantity, the distance trucked. See Table 5.

Solving each of these formulas for each of the 22 classes of trucking distances we get a time allowance in hours per 100 pieces for each class of product for each distance. These time allowances tabulated are shown in Table 6 and 7.

TABLE 7. TIME ALLOWANCES FOR SECOND FLOOR BINS

| Class | Distance in feet—bin to door | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 110 | 125 | 140 | 155 | 180 | 200 | 215 | 230 | 25 |
| 1 | .101 | .103 | .105 | .107 | .110 | .113 | .115 | 116 | .119 |
| 2 | .112 | .114 | .116 | .119 | .122 | .125 | .128 | 130 | .133 |
| 3 | .136 | .138 | .141 | .144 | .149 | .153 | .156 | .158 | 162 |
| 4 | 165 | .169 | .173 | .177 | .183 | .189 | .193 | .196 | 202 |
| 5 | 227 | .232 | .238 | .243 | .253 | .260 | .266 | 271 | 278 |
| 6 | .167 | .169 | 172 | .175 | 180 | .184 | .187 | 189 | .193 |
| 7 | 276 | .281 | 287 | .292 | .301 | .308 | .314 | 319 | .326 |
| 8 | 258 | .263 | 269 | .274 | .283 | .290 | .296 | 301 | .308 |

| Class | Distance in feet—bin to door | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 300 | 330 | 360 | 390 | 415 | 465 | 500 | 520 |
| 1 | 126 | .129 | .133 | .137 | .141 | .147 | .152 | 154 |
| 2 | .140 | .145 | .149 | .154 | .158 | .165 | .170 | 173 |
| 3 | .172 | .177 | .183 | .189 | .194 | .203 | .210 | .213 |
| 4 | 215 | .222 | .230 | .238 | .245 | .258 | .267 | .272 |
| 5 | 297 | 308 | .319 | .330 | 340 | .358 | .371 | 378 |
| 6 | 205 | 208 | .214 | .220 | .225 | .234 | .241 | 244 |
| 7 | 334 | .355 | .366 | .377 | .386 | 404 | .416 | 423 |
| 8 | 326 | .337 | 348 | .359 | .364 | .386 | .398 | 405 |

As the time required to complete a car depends upon the slowest operation of the two, it is necessary to allow the time required for the slowest operation. For this reason each of the computed times in the above table was compared with the time necessary to stow 100 pieces and the largest of the two were used. To this selected time another factor had to be added. It was found that in loading the cars with various products that frequently only a part of a truckload of a given product was required to complete the quota. A study of this item showed that three per cent additional time was required to cover it. Also in finishing out a doorway in a car an extra four per cent was needed and an extra three per cent was needed to cover the bracing of the last car. These three items amount to 10 per cent of the calculated times, so an additional 10 per cent was added to the figures in the table. Furthermore, Classes 6, 7, and 8 being packages were double decked in the bin. In loading trucks an additional item of removing the decking lumber was involved. In cases where the stowing time was longer than the trucking time an additional allowance to cover this item was unnecessary. Therefore we made an allowance to our selected times in each case where the trucking time was 0.038 hours per 100 pieces greater than the stowing time.

These final values were all tabulated and transferred to a chart for convenience. This chart, Fig. 1, is used in the following manner.

Shipping orders are issued to the warehouse foreman 24 hours in advance of the day on which they are to be shipped. Opposite each item on the shipping order he designates the number of the bin from which the item is to be obtained. In this manner the systematic turnover of the stock is assured. He then assigns each shipping order to one of the checkers and turns the order over to the department clerk. The department clerk then figures the time allowed for each item as follows: From the chart he obtains the hours per 100 pieces from the designated bin to the assigned checker's door and multiplies this by the number of pieces required on the order. This allowed time is noted on the shipping order for each item and the sum of the allowances for all the items is obtained for the car.

As the day is the unit on which bonuses are paid, the sum of the time allowances for all cars assigned to a crew is obtained. Thus a crew may be slightly behind on one car but make up the time on the next and complete its bonus for the day. The bonus consists of 25 per cent of the time allowed.

It generally happens that six cars per crew will make an allowance close to 10 hours. At times the allowance will be a little more than 10 hours but it seldom happens that the crew will have to work more than the 10 hours to complete the day's work because the tasks are liberal enough to allow of their being exceeded by about 10 per cent. On the other hand if they finish in less than the 10 hours the crew is allowed to go home. As an example, suppose a crew whose time allowance for the day was 10.24 hours, finished at 5 o'clock. These men would check out and go home at 5 o'clock instead of at 5:30. They would be paid for 10.24 hours plus the 25 per cent bonus of 2.56 hours or a total of 12.8 hours at their regular day rate.

The foreman of the shipping crews is paid a daily bonus of 30 cents per day for each car loading crew that makes its bonus for the day and when all shipping crews earn their bonus on a given day he receives 50 cents per crew. In this manner we obtain the interest and co-operation of the foreman who sees to it that his crews are built up of the right sort of men, and this relieves the executives of a lot of worry about the turnover of the crews.

As bracing is required in all cars there were three bracers employed. Study showed that two bracers co-operating should be able to do the required work, without holding up the loading crews. The bracers

were reduced to two in number, and paid a bonus of 17½ cents per car braced on which bonus had been earned by the loading crew. The total bonus earned per day is divided equally between the two bracers. This bonus was sufficient to obtain the co-operation of the bracers with the loading crews and with one another.

This bonus plan has been in effect for over a year with excellent results. The loading crews have been reduced from 36 to 18 men, the bracers from 3 to 2 men making a total saving of 19 men. To handle the extra clerical work required to operate the bonus requires the services of a clerk half his time. During the past 8 months there were only 3 cases of lost bonus among the crews and labor turnover has been reduced on this job to practically zero. The men on the job are happy in that they are now earning more than they could earn anywhere else, and are anxious to hold on to a good thing.

The installation was made without opposition or ill feeling on the part of the men. Only one crew was started on a bonus at a time and they were continually coached in their new mode of operation by the time study men until it became habit. The second crew was not started on bonus until after the first crew was thoroughly trained and confident of their ability to meet the task every day. The second crew was then taught the new method and after that the third crew.

Each man receives daily a slip showing him exactly what he earned the day before, and these slips are looked forward to with a great deal of interest by the men who keep them for long periods and show them with a great deal of pride.

# Special Truck Cuts Handling Time in Half

U. S. WOOD, labor foreman at the Southern Pacific Railroad shops at Tracy, California, designed and built the special truck shown in the two accompanying views. It is intended to handle locomotive air pumps (either Westinghouse or New York). So successful has it been that five men now easily handle a pump in half the time which a crew of seven or eight men formerly used to require for the work.

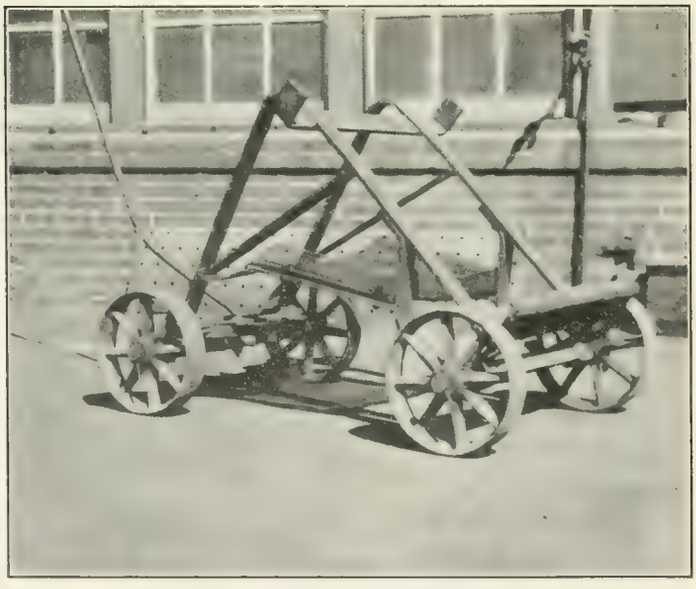

FIG. 1 AIR PUMP WAGON WITHOUT PUMP SHOWING CONSTRUCTION OF WAGON FROM SCRAP

The truck is made from odd pieces of structural steel and scrap iron available in the shop. Its construction is shown in Fig. 1 and the method of loading the air pump in Fig. 2.

In loading the pump on the truck the front wheels are raised vertically above the rear and a piece of ¾ in. pipe, sufficiently long to reach across the truck, is placed through the spokes of the rear wheels to prevent the truck from moving during the loading operation. With the truck in this raised position the step with a ½ in. grab iron is slipped underneath the pump. The grab iron grips the lower side of the pump, the method of engaging being slightly different in the case of pumps of different makes. With the pump in this position the truck is then tilted over until the front wheels strike the ground, brackets on either side of the truck hold the pump in place from shifting sideways.

When loaded the pump is moved anywhere with ease, and is usually left on the truck until it is taken to the locomotive where it is to be attached. The unloading process is as simple as loading.

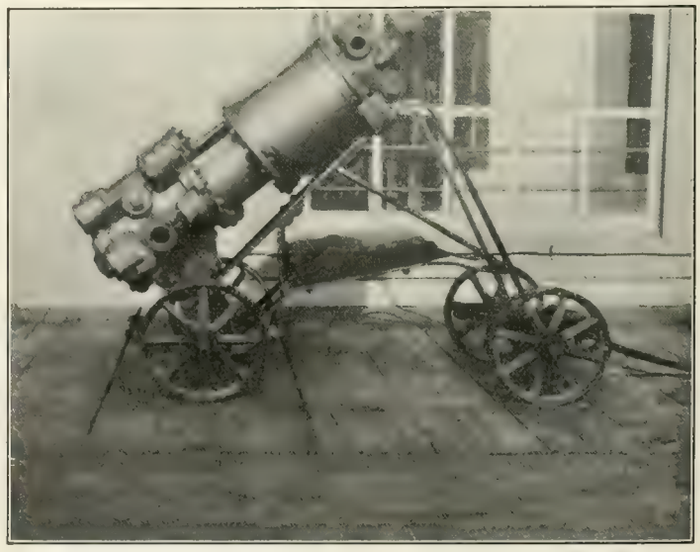

FIG. 2 AIR PUMP WAGON CARRYING PUMP

# Finding Causes of Quality Variations

## A Fundamental of Control Through Inspection

By W. A. SHEWHART

*Bell Telephone Laboratories, Inc.*

IN this paper I shall consider only one fundamental inspection problem. It was Patrick Henry, I believe, who said, "I have no way of judging the future save by the past." The problem of finding the *best* way of judging the future in terms of the past is the fundamental problem which I wish to consider.

All of us know that experience counts; that it counts with one proviso, namely, that we know how to use it. I shall try to present some fundamental principles indicating the best way to analyze and interpret the past so as to forecast the future, i.e., to make the best use of the data of experience. Naturally the problem of how to make the best use of data does not belong to engineering inspection alone, because others than inspectors are supposed to make use of their experiences. Hence my remarks are based upon a survey of the results of efforts to solve this fundamental problem in many fields of human endeavor.

**This paper forms the basis for answering the following important inspection problem: When do the observed differences between product for one period and product for another period indicate non-uniformity? When do quality differences of manufactured product, observed from one period to another, indicate fortuitous, chance or random variations produced by non-assignable causes which cannot reasonably be controlled without radically changing the manufacturing process; and when do observed quality differences indicate the possible existence of assignable causes which can be found and controlled?**

For our present purpose we may classify all experience into two classes. One class contains those data, observations and perceptions which can be explained in terms of known laws of physics, chemistry, biology, economics and the other sciences. As an example, we can explain the occurrence of the eclipses of the sun, the motions of the planets, the operation of an induction coil and so on, indefinitely.

The other class contains the great mass of data or observed phenomena which cannot be explained satisfactorily in terms of known laws and which, therefore, are attributed to chance. Witness, for example, your state of health, the weather, the rise and fall of the stock market, the motion of molecules or electrons and practically all of our everyday experiences.

Naturally we desire to make use of both classes of experience.

By a very slow and laborious method of observation, hypothesis, deduction and experimental verification, we have been attempting throughout the ages to reduce our experiences to known laws. It has been natural for man to seek some law which would explain the future in terms of his past; to seek, as it were, something which would remain constant throughout all time. Obviously, in so far as man by scientific methods has been able to reduce his experiences to natural laws which persist throughout the future, he has been able to attain his object of judging the future in terms of the past. This human effort has been going on throughout the centuries with the result that we live in a scientific age—in an age when not only individuals and corporations but even nations plan their future in accordance with established laws of science.

Not everything in our experience, however, has been brought successfully under known laws; in fact as already noted, most of our experiences cannot be made use of in accord with established law. How then can we make use of such data which constitute the major portion of our experience? The real advance in the solution of this problem has come within the past 271 years, since the time when the chevalier de Mèré, the gambler, proposed to that famous mathematician, Pascal, the first problem in the theory of probability, which arose out of a game of chance being played by de Mèré. Within this period we have turned from the old unprofitable conception of chance to a new and profitable conception of *laws of chance*.

In Fig. 1 I have tried to illustrate the central idea underlying the progress that has been made within the past two centuries dealing with that great body of our experience attributed to chance. Throughout the history of the ages we find again and again the recurring idea that chance results are those which do not happen according to any law. The history of the change in man's ideas of chance is largely associated with the history of his superstitions and his religion. If a thing happened at the hands of chance, it might be considered as the oracle of the gods or as a run of luck, either good or bad. Hence it was that probably no two individuals would interpret the bearing of the past experience upon the future in exactly the same way. How could they, for it was their belief that there was no particular universal law or laws behind such experience. The experiences of the future

were in the hands of the gods and were not necessarily foreshadowed by the experiences of the past.

This condition is represented by the left half of Fig. 1. The only useful experience under this view is that small portion reducible to law represented by the white area. Obviously it would be impossible to use the large fraction of experience represented by the dark area, upon the hypothesis that such experience foretells nothing about the future.

Within recent years, however, we have been coming more and more to the view that chance results represent the effects of a complex system of causes or natural laws.[1] We are coming more and more to the viewpoint of LaPlace that, if we knew at any instant all of the natural laws, we could foretell with precision all future events. We are coming more and more to the viewpoint of that great Danish actuary, Thiele, that everything that happens is the necessary consequence of a previous state of things. We are coming to see chance results, therefore, as the outward expression of numerous unknown laws of nature operating in such a manner that their resultant effects vary within limits which do not change with time.

It is useful therefore to view the resultant effects of this complex system of causes as happening in accord with a *law of chance*, which, when discovered through a study of chance data makes it possible for us to forecast future events *within certain limits;* whereas natural laws enable us to forecast future events with certainty. This change in viewpoint marks the beginning of the development of comprehensive methods for using chance data.

## Theory of Best Available Methods

I wish, now, to outline the high points in the theory underlying the best available methods for making use of chance data or experience. A list of references to the original memoirs of the past 271 years which have contributed to these methods would run over a thousand. Among the list of authors we should find the names of four of our greatest physicists, Jeans, Gibbs, Planck and Lord Kelvin; four of our greatest mathematicians, LaPlace, Poisson, Charlier and Gauss; four of our greatest statisticians, Pearson, R. A. Fisher, Edgeworth and Yule; two of our greatest actuaries, Thiele and Gram and two of our greatest astronomers, Eddington and Kapteyn. This list could be extended by citing leading representatives from the field of medicine, biology, agriculture, geology, psychology, education, sanitation, engineering and so on.

Naturally, therefore, all that I can hope to do is to bring a survey of the results of countless investigators living within the past 271 years who have undertaken to find the best way of judging the future in terms of chance data or chance experience by making use of *laws of chance*. With the aid of some of the most modern mathematical tools it is possible to lay a comparatively solid foundation for the method of attack which has been devolved.

[1] Incidentally, of course, we have come to believe that our so-called natural laws of physics, chemistry and the other experimental sciences are but approximations to the true laws of nature.

## Insurance Business Built on Laws of Chance

Although we cannot at this time enter upon the discussion of mathematical foundations underlying the method for using chance data in helping to judge the future, it may be well to recall some of the instances

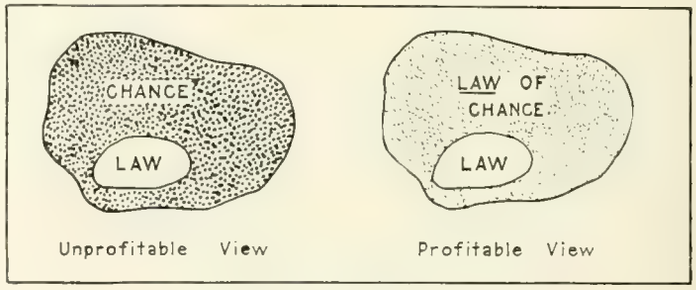


Fig. 1 Why Do Things Happen?

where the method has served a very useful purpose. Possibly one such illustration is sufficient. Perhaps the greatest monument to the practical utility of established laws of chance is the insurance business. Without much question the insurance business is one of the soundest in the world. For this business to grow from practically nothing in the short course of not much over two centuries, to a business which today is among the greatest is indeed a tribute to the economic

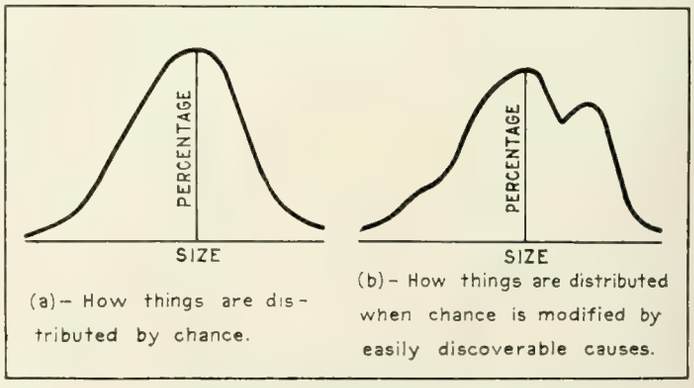
PERCENTAGE
SIZE
(a)- How things are distributed by chance.
PERCENTAGE
SIZE
(b)- How things are distributed when chance is modified by easily discoverable causes.

Fig. 2 Schematic Representation of Method for Determining Causes of Variations

usefulness of laws of chance in forecasting the future in terms of past experience.

The widespread growth of statistical departments in many of the leading corporations of the United States and other countries bears testimony to the accepted usefulness of some of the very elementary principles of the generalized method to be presented forthwith. Already a very widespread movement has started in Germany among the manufacturing organizations such as the Krupp's Works in which statistical methods are being used.

## How the Need for a Law of Chance Arises

All interested in engineering inspection realize that it is practically impossible to make two things which

are identical. All realize, when a manufacturing process is established to produce a product meeting certain specifications, that one unit of product will differ from another. We attribute this condition to the existence of uncontrolled factors such as possibly temperature, humidity, the physiological and psychological conditions of the personnel, wear and tear on the machinery and numerous other similar factors. Obviously it would not be practical to exert absolute control over all of these factors. In other words a better control of product would mean a better control of a large number of factors, and hence it would probably not be economical.

If, however, there are one or more major causes of variation in the product, it is reasonable to expect that appreciable improvement in quality of production may be effected by modifying these factors. But how is the manufacturer to know when the variations in product from one month to another are those which may be attributed to chance, that is, attributed to a complex system of causes which it would be exceedingly difficult to control, and when is he to know that the variations in the product are such as indicate that

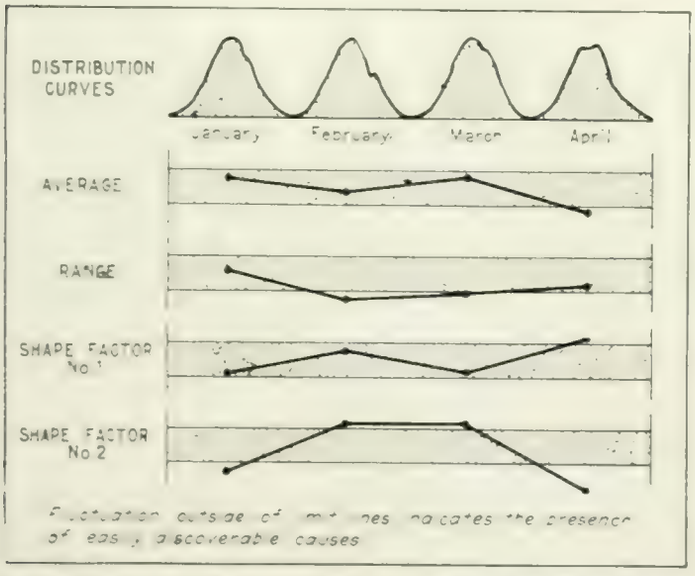


FIG. 3 SCHEMATIC FORM OF CONTROL CHART FOR VARIATIONS

there are one or more predominating causes of variation which it should be within his power to discover easily? In other words, how can the manufacturer use his past experience in respect to a given product in the best way to indicate the action that he should take in trying to modify this product?

## HOW THE LAW OF CHANCE REVEALS ITSELF

Statistics comes to his aid and says, if the given kind of product is distributed as indicated in Fig. 2 (left) it is likely the differences between the units of product result from a complex system of causes whose effects would be difficult to separate. If, however, the product is distributed in the manner indicated by Fig. 2 (right), statistics says there are certain easily detectable primary causes of differences between the units of the product. These figures must, of course, be interpreted as a schematic representation of the fundamental idea underlying the method of detecting the existence of other than chance causes.

In other words events happening according to a law of chance, in the long run, distribute themselves in respect to size according to an approximately smooth distribution which persists unchanged throughout all time, whereas events happening according to a law of chance superposed upon a few primary causes distribute themselves in respect to size according to an irregular distribution which probably changes with time.

Perhaps we should call attention to the phrase "in the long run" used in the previous sentence. Its significance will be quite apparent upon second thought. We know from experience that the more observations we have the more likely we are to find that the observed distribution will apparently approach a smooth curve: in the long run, or when a very large number of observations are available, the distribution curve will be approximately smooth.

## NUMBER OF OBSERVATIONS

But, you say, "We can't afford to take an infinite number of observations in order to discover if the observed distribution of data fit a smooth curve as shown in Fig. 2a." No, possibly we can't afford to take more observations than we do now, but possibly we take too many now, at least more than we need in some instances, if we use the latest methods for analyzing data referred to in the next paragraph. How then are we to discover whether or not an observed set of data are consistent with a law of chance? If they are, what is this law? I bring up these questions because they are customary stumbling blocks. Space does not permit the presentation of technical answers.

A survey of the really remarkable achievements made within the past three decades in providing answers to these questions could not but prove interesting, but the following remark must suffice: The labors of a comparatively few great minds within recent years have provided us with methods for finding with a fair degree of certainty the law of chance behind a given set of data when that law exists. Probably I should not pass this point without the warning, however, that we cannot rely upon the eye to tell us that an observed distribution is smooth and of such a nature as to justify our assumption that the data are the sole results of a law of chance. Neither would the statistical methods of even the previous generation suffice in answering the questions propounded at the beginning of the preceding paragraph. Let me quote in this connection from a book by R. A. Fisher of the Rothamsted Experiment Station, England, who has made significant contributions to the answers to these questions. "Little experience is sufficient to show that the traditional machinery of statistical processes is wholly unsuited to the needs of practical

research.[2] Not only does it take a cannon to shoot a sparrow, but it misses the sparrow! The elaborate machinery built on the theory of infinitely large samples is not accurate enough for simple laboratory[2] data. Only by tackling small-sample problems[3] on their merits does it seem possible to apply accurate tests to practical data."

### Interpreting the Future in Terms of a Law of Chance

Let us next see how a law of chance can be used in forecasting future events: let us see how we can judge the future in terms of the past with the aid of a law of chance. As previously noted, a law of nature foretells how a thing will happen, a law of chance foretells within what range a thing will happen, or specifically a law of chance gives the probability that a thing will happen in a certain way. To enlarge upon this point:

Suppose a complex system of causes operates to produce things which differ in size according to a law of chance. Suppose that the things produced in a given period are examined for size and the observed distribution of sizes is plotted. Suppose that this is done for several consecutive periods and the results are compared. Naturally, the observed distributions will probably differ in one or more or even all of the following characteristics: average or central tendency, range or dispersion, and shape. So long as all of the sizes are controlled by the same law of chance, however, it is practically certain that, from one period to another, the differences in either average, range or shape will fall within certain easily determinable limits.

### Telephone Transmitters as an Illustration

As an illustration, suppose we consider the production of telephone transmitters. Even when all precautions are taken, there is some variation in the efficiencies of various individual transmitters. We attribute this to many factors: we know, for example, that the efficiency depends upon the vibratory characteristics of the instrument; upon the properties of the carbon; upon the details of assembly and similar factors. Here, we have a lot of factors or causes which modify the efficiency. In turn each of these factors depends upon others in a manner not easily measurable and not thoroughly understood. So long as the effects of the interaction of this complex system of causes follow a law of chance we can expect the differences in either average, range or shape of observed distributions of efficiencies of transmitters from one period to another to fall within certain easily determinable limits.[4]

But what if one average, range or shape vary outside these established limits? The fact that one of these characteristics goes outside the limits indicates that the system of causes has probably changed; in other words that, superposed upon the random or chance system of causes, there are probably one or more major causes which can be discovered with comparable ease and possibly controlled. These limit lines are the engineer's fever thermometer. With their help he can tell when the product needs attention.

I have presented a schematic form of control chart in Fig. 3, illustrating the ideas just considered.

*To summarize:* The problem is, to find the best way to judge the future in terms of the past; the solution is, when possible, reduce the data to natural laws, when not possible, reduce the data to laws of chance. To make use of the greatest portion of our experience we must use the second method which is really not much older than we are, hence practically unknown. In closing, let us look at the industrial development based upon applied scientific laws, making use of only a small fraction of past experience, and then think of the industrial development of the future based upon applied laws and applied laws of chance thus making best use of all of our data.

[2] Or inspection, let me add.

[3] A paper on this subject by the present author will probably appear in the Bell Technical Journal for April, 1926.

[4] For an amplification of this concept of causation as a constant system of causes see my article in the Journal of the American Statistical Society, December, 1925.

## Speculators or Machine Builders

THE letterheads of a certain machine shop proudly boast that it was established in 1848, and the general appearance inside and out bears out the claim. The original owner made money, sold out and died well off. His successor, who came up from the shop, had years of lean times, then made money, sold out and likewise died with a fortune. Some half a dozen men have taken substantial sums out of this old shop, and yet there is no modern equipment.

The word efficiency is never uttered inside the shop. Workmen come and go and do about as they please; someone orders castings from time to time, but usually the foundry makes what it seems likely the shop will use. The firm's credit is always good; overhead expenses are light. There may have been drawings once, but now they go by a book in the foreman's pocket.

The cycle of events is about like this: Mr. Blank made his pile and then sold the shop to the foreman. Mr. Foreman tells everyone business is dull and lays off most of the help. Gradually he hires them back at much lower wages. After a while he has the shop full, which means half the necessary men.

These men make machines, engine lathes, perhaps, in dozen lots and fill up the spare space in the shop. When the shop is full the old barn out back is used for a storehouse. When that is full there is a war, or export trade booms, or automobiles come into fashion, and storehouse and shop are emptied in no time at top prices. The present owner, Mr. Foreman, sells out to his foreman, and so on, all over again.

The question is, are these people machine tool builders or speculators in machinery? If they are speculators, why do not we all speculate?

# Saving Money on Shipping Containers

## Specific Points and Requirements to Consider

PREVIOUS articles[1] have discussed many of the factors entering into the selection of the correct shipping container for manufactured products. A few of the points brought out need further amplification.

*Assembly work on containers.* Wood boxes, if received knocked down to reduce storage space, cannot be put together economically by hand in large quantities. A nailing machine is a warranted expense especially in larger plants. The wirebound box comes in three parts—the 4-section main mat and two ends. After folding three sections of the mat to shape and fitting the mortised and tenoned ends of the cleat together, the joints are nailed, or can be quickly stapled on a special machine where the number of containers used is large. The fourth side forms the cover. The ends are dropped in place and nailed with one-tenth the number of nails used in the ordinary box. Fiber board containers are usually all in one piece, the joints being glued with tape strips. They are unfolded and are glued, or stitched or stapled with copper wire by machine, along the bottom, after which they are ready for filling.

Courtesy, Office Ass't Manager, Washington

FIG. 1. SPACE SAVED BY SUBSTITUTING WIREBOUND BOXES (UPPER ROW) IN SHIPMENT OF ARMY HELMETS

*Relative cost of packing.* This cost depends directly upon the conveniences supplied to the force of packers, and usually decreases with the increase of such equipment. For large outputs of small package goods the products are usually delivered on conveyors alongside of which the containers are stacked ready for filling. Where wood boxes are used a nailing machine is more economical than hand labor to put on the cover. With fiber board boxes, if hand closed, it is necessary merely to fold in the ends and glue the flaps or seal the joint. Automatic sealers do this work much more economically where output is large. The wires on the wirebound box act as cover hinges, and it is necessary only to fit the mortised and tenoned cleats together and twist the wires. For heavy shipments, the cover may be nailed to the battens on the ends of the box.

*Cost of auxiliary equipment.* With ordinary wood boxes a nailing machine must be employed to handle large quantities. With fiber board boxes and wirebound boxes and crates a stapling machine is advisable to put the containers together for packing. A sealing machine is worth-while to close the tops of fiber board containers where the output of the plant is large. A Bruce, Bauwens, or similar type of twister is required for fastening down the covers of wirebound boxes and crates.

*Salvage value of containers.* The wood box or crate, particularly if put together according to recommended specifications for safe shipment, is apt to be broken or injured in opening. The cover, at least, is usually rendered unfit for further service and a new one has to be made. The box may be used for storage, or else broken up for firewood.

The wirebound box is opened by cutting the wires and raising the lid, like that of a trunk. By the use

FIG. 2. [illegible]

[1] See the October 1925 issue, pp. 199-200 and the November 1925 issue, pp. 271-2.

of wire filler pieces now on the market, it can be used over again for shipments. Retwisting the original wires would break them off. There is not so much temptation to burn this box as it is not so easy to break up.

Fiber board containers, likewise, will stand more than one shipment, as covers can be kept intact even when they have been glued down. The use of sealing strips along the joints will again make the boxes proof against theft.

Eventually the fiber board box finds its way into the waste paper pile for sale as scrap, to be reutilized.

*Convenience and saving to dealers.* The use of cheap, light, compact containers, designed for safety, often enables the manufacturer to send to the dealer in one package all parts needed for a complete installation, as, for instance, electrical fixtures, where chain, pipe, wire, sockets, globes, reflectors, etc., for one unit can be partially assembled and then packed together. These articles can be resold in the original packages without the necessity of opening a number of boxes of parts, and collecting the individual pieces for each sale. Dinner sets, when shipped in bulk in casks, are packed in hay or excelsior, and each piece is separately wrapped, necessitating a complete unpacking and sorting of contents to assemble individual sets. The use of fiber board containers has enabled the manufacturer to pack each complete set in one box, which need not be opened in the dealer's warerooms. He thereby saves shipping charges, trouble of unpacking and cleaning up the dirt, and cost of repacking for retail delivery, which averages over a half hour in the time of one man for a 100-piece set. The packing of case groceries in dozen and two-dozen lots in fiber containers enables retail dealers to save many unpacking and repacking costs because the sale of goods in case lots is stimulated.

*Sales appeals to customers.* Containers holding assembled products, with suitable printing or decoration on the outside, enable dealers to make attractive displays which exert strong sales appeals. Moreover, customers are usually more strongly attracted to an article assembled and inspected at the factory before shipment. The convenience of case goods in small lots is often an attraction to quantity sales.

*Special requirements.* Certain products must be shipped in special containers. The above discussion has covered only the wide range of general manufactured products that are shipped in boxes or crates. Liquids must be shipped in casks, barrels, kegs, drums, or cans, and legal restrictions are placed on the packing and transportation of all materials which are inflammable or explosive. Many chemicals, likewise, must be shipped, or can most economically be transported, in such containers. But the use of casks or barrels for manufactured products other than liquids and chemicals is diminishing in extent on account of their cost, weight and waste of room in transportation and storage.

Sacks and burlap covers still find extensive, economical use, the former not only for agricultural products but also, as in the Ford industries, for the shipment of small automobile, machine, and other parts; for pipe fittings, etc.

*Legal requirements.* Laws, rules and regulations of the Interstate Commerce Commission, postal department, American Railway Express, Bureau of Explosives and other divisions of the American Railway

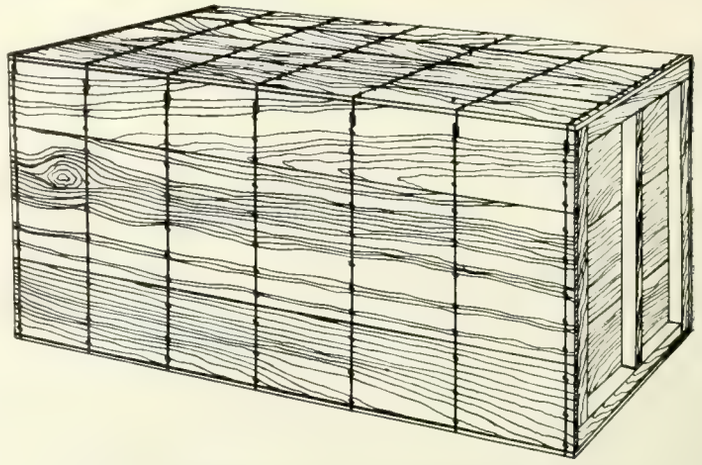

FIG. 3 WIREBOUND BOX FOR DOMESTIC SHIPMENTS

Size 40 x 20 x 20 in., with grain of lumber along 40 in. dimension, or length of the box.

Association, are very definite on what commodities may be shipped in each type of container, according to whether it goes by freight, express, or parcel post, and what specifications must be followed regarding size, shape, materials, packing, etc., for the containers.[2]

In addition to these safeguards, shipping container manufacturers are co-operating in scientific research and testing to further improve the art of making containers, so that the damage and loss in shipments may

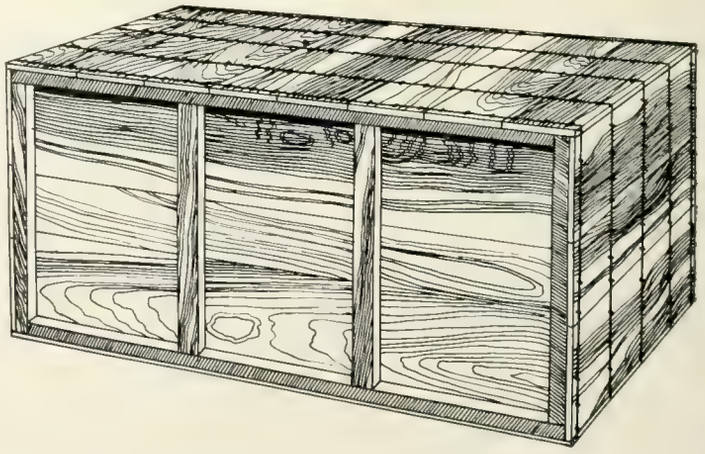

FIG. 4 WIREBOUND BOX FOR EXPORT SHIPMENTS

Size 20 x 40 x 20 in., with grain of lumber along 20 in. dimension to better resist blows and crushing.

be reduced to an even lower figure than that to which it has already been reduced.

[2] These rules and specifications can be obtained in booklet form from any manufacturer of containers, or from the National Association of Box Manufacturers, the Paperboard Industries Association, and the Wirebound Box Manufacturers' Association, as well as from the above.

# Guide to Latest Information

## One Hundred Best Selections for February

By THE EDITORS

## Industrial Buildings and Plant Maintenance

### Buildings and Equipment

**1925 Industrial Construction Shows Recovery. 658.2**

Robert T. Mason. *Iron Trade Review*, Jan. 7, 1926, pp. 57-9, 121. Illus. Statistical study of industrial building during 1925.

**Standard Gypsum Company's Two New Plants in Operation. 658.2**

W. A. Scott. *Cement, Mill and Quarry*, Dec. 20, 1925, pp. 9-11. Illus. Description of two new Pacific Coast plants just completed and put into operation.

**Scientific Planning for the New Western Electric Plant. 658.2**

O. C. Spurling. MANUFACTURING INDUSTRIES, February 1926, pp. 101-6. Illus. Comprehensive survey of factors influencing location of new plant of Western Electric Co., at Kearny, N. J. Detailed data on buildings including type of construction, materials and fixed equipment.

**Reconstruction of a Paper Mill in Washington. 658.2**

R. A. Hunsta... *Engineering News-Record*, Dec. 24, 1925, pp. 1030-1032. Illus. Details of design and layout of a new building of steel and reinforced concrete with walls of wire glass and steel sash. The machinery was kept in operation while the old building was replaced with the new structure.

**Large Universal Plate Mill in Great Britain. 658.2**

Joseph Horton. *Iron Trade Review*, Dec. 31, 1925, pp. 1643-6, 1656. Illus. Description of the Moss End Works, of Stewart & Lloyds, Ltd. Clydesdale, Glasgow, Scotland.

**Automotive Proving Grounds of the General Motors Corporation. 658.2**

O. T. Kreusser. *Journal of the Society of Automotive Engineers*, Jan. 1926, pp. 27-32. Illus. Gives the layout, facilities and activities relating to the road test of motor vehicles. Proving ground covers 1125 acres.

**Lighting the Way to Better Shop Production. 658.2**

R. S. Crandall, *Iron Trade Review*, Dec. 17, 1925, pp. 1525-7. Illus. Shows increase in production due to improved illumination in machine shops. Also discusses the safety factor.

**Substituting Steel for Wood in Building Construction. 672**

Henry R. Brigham. *Iron Trade Review*, Dec. 31, 1925, pp. 1648-50. Illus. Outlines opportunities for extending use of metal as a substitute for wood in building construction.

### Maintenance and Repair

**Control of Mechanical Power Transmission. 658.262**

William Staniar. *Industrial Management*, Jan. 1926, pp. 49-54. Illus. Fifth of a series of articles on transmission applications.

**Silent Chain Drives on Industrial Equipment. 658.262**

Frank E. Gooding, *Industrial Engineer*, Jan. 1926, pp. 8-12. Illus. Gives analysis of reasons for using such drives, operating results obtained and examples of typical installations.

## General Management and Policy

### Economics and General

**Economic Statistics. 31**

W. L. Crum and A. C. Patton. A. W. Shaw Company, Chicago. 492 pp. $6.00. A text prepared for the needs of students who are interested in the application of statistical methods to economic problems. The purpose is to enable a student who does not have extensive mathematical training to become familiar with statistical processes and acquire a working knowledge of their applications in economic analyses. The principal subdivisions are: Statistical Data; General Analytical Methods; Analysis of Time Series; Appendix—tables, symbols, bibliography, etc.

**Essays in Economics. 33**

Edwin R. A. Seligman. Macmillan Co., New York. 394 pp. $4. A series of writings and lectures covering the experiences of 40 years and falling naturally into three divisions: Contributions to the history of economic doctrine; problems of economic theory; and questions of economic policy. General in nature and not devoted specifically to business. Chapter headings comprise: Continuity of economic thought; Owen and the Christian Socialists; neglected British economists; history of economics in the United States; economic interpretation of the war; railway tariffs and the interstate commerce law; crisis of 1907; immigration; social progress; social aspects of economic law; economic problems of the modern dentist; the social evil; the real university; American Association of University Professors—its [illegible] and accomplishments.

**Relation of Government to Industry. 33**

M. L. Requa. Macmillan Company, New York. 241 pp. $2.50. An analysis of the fundamentals of human progress leading to the thesis, "Progress of this kind cannot be halted." By historical references the author endeavors to show that paternalism in government and attempts to frustrate economic law by government are unsound; that there is a sharp distinction to be observed by government in its relation to public utilities and other industrial enterprises; that much public service is best rendered by monopolistic control, that [illegible] on the basis of industrial prosperity; that government supervision is detrimental to public welfare; that [illegible] in the interests of community. The author modestly deprecates the inadequacy of his presentation, but the reader will find much to stimulate constructive thinking.

### Management

**The Administration of Industrial Enterprises. 658.**

Edward D. Jones. Longmans, Green & Co., New York. 618 pp. Revised. $4.75. Revised edition of a work originally published in 1916, which has had an enviable record. It was one of the earliest treatises on the application of [illegible] management in industry, with emphasis upon the economic policies involved. This revision has been rewritten and the amount of new material added exceeds in

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* The articles and books classified by topic and briefly described, are selected from current publications by the editors of MANUFACTURING INDUSTRIES as those most worthy of serious attention by officials, managers and executives of manufacturing concerns. The items are chosen from upwards of 100 leading technical magazines and the publications of some 50 professional societies and book publishers. The editors will be glad to furnish additional information and references on request.

The number at the right of each item is the index symbol of the Dewey Decimal Classification system. If articles are clipped and filed according to these numbers, like subjects will automatically be grouped together and related subjects will follow in logical sequence. The books and pamphlets classified can be procured from the Ronald Press Company or their respective publishers. Photostat copies (white printing on black background) of any magazine article indexed can be obtained at a price of 10 cents per page, by addressing the Engineering Societies Library, 29 West 39th Street, New York City, with whom we have arranged this service. Remittance must accompany the order. When ordering photostats please quote from the index: (1) Title of article; (2) Index number; (3) Name, date and page numbers of periodical in which the item appears.

quantity the subject matter of the first edition. The aim in treatment, which has been substantially achieved, is the formulation of general principles as a basis of controlled action in manufacturing. Both American and English practice have been drawn upon for case material.

**Business Facts and Their Uses in Management and Control. 658**

E. W. McCullough. *Brick and Clay Record,* Jan. 5, 1926. pp. 37-41. Has particular reference to the manufacture of face brick.

**Capitalizing the Advantages of the Small Factory. 658**

Dale S. Cole, *Industrial Management,* Jan. 1926. pp. 27-31. Fourth of a series on the small factory.

**Getting the Most Out of Your Machine Tool Dollar. 658.27**

G. S. McKee. *American Machinist,* Dec. 24, 1925, pp. 995-997. The Timken Roller Bearing Co. works machine tools to the limit of capacity. Its management believes that coming developments will soon outclass much of the existing equipment.

**Getting the Most Out of Your Machine Tool Dollar. 658.27**

Wm. Hartman. *American Machinist,* Jan. 7, 1926, pp. 1-4. Outline of National Cash Register policy that a new machine to justify its purchase must pay for itself within one year.

**How Human Element Influences Grinding. 658.386**

Herbert R. Simonds. *Abrasive Industries.* Dec. 1925, pp. 371-3. Illus. Instruction system planned to overcome the influence of individual knowledge and skill in precision grinding.

**Business Outlook in the Machinery Field. 658.5**

*Machinery,* Jan. 1926, pp. 367-373. A summary of the opinions of chief executives in all branches of the machinery building field. Opinion is that outlook is encouraging.

**The Industrial Museum. 658**

Charles R. Richards. The Macmillan Company, New York. 117 pp. $3.00. A volume dealing with the great industrial museums of Europe, publishing at a time when several efforts are being made to arouse interest in such institutions in the United States. Museums of Paris, London, Munich and Vienna are presented in detail, with illustrations of buildings and exhibits, information on organization and costs of operation. Without doubt the most helpful book available to American readers on its subjects. Of interest to industrialists and educators.

**The German Museum in Munich. 658**

Oskar von Miller. *Mechanical Engineering,* Jan. 1926. pp. 21-26. Illus.

**Business Law. 658(C07)**

Alfred W. Bays. Macmillan Co., New York. Revised edition. 473 pp. $1.40. Devoted to building up a thorough understanding of the applications of law to business operation, and written in a plain manner to remove confusion. Useful to business men and also to students. Part I—Preliminary discussion. Part II—Contracts—offer, acceptance, fraud, mistake, the consideration, legality; form and expression; written contracts; transfer and discharge. Part III—Agency. Part IV—Sales of goods. Part V—Negotiable paper. Part VI—Business proprietorship: Partnerships—kinds, capital, property, rights of partners, remedies of creditors, dissolution; corporations—organization, powers, shares; trusts. Part VII—Law of property: Fixtures, estates; uses and trusts; mortgages and deeds; wills. Part VIII—Other laws: Taxation; unfair competition; public regulation; laws regulating business.

**A Plan for Simplified Checks. 657.24**

Frank W. Simmonds. *American Bankers' Association Journal* Jan. 1926 pp. 463-4, 521. Outlines agreement effective March 1, 1926, to standardize the size and arrangement of bank checks.

**The Vital Need for Greater Financial Support to Pure-Science Research. 658.57**

Herbert Hoover, *Mechanical Engineering,* Jan. 1926, pp. 6-7. First Henry Robinson Towne lecture on the relation between engineering and economics.

**Uniform Invoice Wins Approval. 658.773**

*Michigan Manufacturer and Financial Record,* Jan. 2, 1926, p. 7. Summary of application of uniform invoice developed by the purchasing department of Ford Motor Co.

**Progress in Textile Mechanical Engineering. 677**

Textile Division, American Society of Mechanical Engineers. *Mechanical Engineering,* Dec. 1925, pp. 1139-40. Report of the Executive Committee of the Textile Division of the American Society of Mechanical Engineers.

**Progress in the Wood Industries as Related to Mechanical Engineering. 674**

Wood Industries Division, American Society of Mechanical Engineers. *Mechanical Engineering,* Dec. 1925, pp. 1137-8. Report of the Executive Committee of the Wood Industries Division of the American Society of Mechanical Engineers.

**Successful Industrial Management. 658**

J. Seton Gray. *Machinery,* Dec. 1925, pp. 303-4. Management must watch costs, have correct information, develop foremen, stimulate loyalty of employees, pay fair wages, have few rules, keep down labor turnover, and train understudies.

# Power Generation and Transmission

## Fuel

**The Case of Bituminous Coal. 662.6**

Walton H. Hamilton and Helen R. Wright. The Macmillan Company, New York. 310 pp. $2.50. This volume is the second issued by the Institute of Economics dealing with the coal situation in the United States. It is limited to an analysis of the current situation and of the prevailing tendencies in the industry, but does not include any proposals for reorganization. It is worth reading at this time when the situation in the coal industry is so critical, and when active search is being made for information which will assist in forming a judgment as to what remedial methods should be applied.

**Wood Refuse Burned on Underfeed Stokers. 658.261**

C. M. Garland. *Power,* Jan. 12, 1926, pp. 46-9. Illus. Equipment and practice of the Graham Bros. plant where either bituminous coal or wood refuse is burned. The system of handling wood refuse insures both safety and flexibility in operation.

**Burning Fuel Oil. 658.261**

Frank A. Rothwell. *Power Plant Engineering,* Jan. 1, 1926. pp. 23-26. Illus. Report of factors governing successful burning of fuel oil.

**Fuel Utilization and Economy in Candy Manufacture. 658.26**

Edwin Schlesinger. *Industrial Gas,* Jan. 1926, pp. 9-10, 22, 24. Outlines the heating and cooling systems of a candy factory classified according to the methods of production and distribution and showing the kinds of fuel used.

**Power and the Coal Crisis. 662.6**

J. F. Perry. *World Power,* Dec. 1925, pp. 293-302. Problems of labor and power, coal conservation, economical supply of power, equipment of collieries, safety, in the British coal industry.

## Power Plant Operation

**The Power Engineer Is Properly a Management Official. 658**

T. A. Marsh. *Steam Power,* Dec. 1925, pp. 6, 8.

**Improvements at the Miami Paper Company. 621.311**

*Power Plant Engineering,* Jan. 15, 1926, pp. 158-60. Illus. Description of new equipment installed in the power plant of the Miami Paper Company. Includes coal handling equipment.

**Special Furnaces Required for Wood Waste. 658.261**

*Power Plant Engineering,* Jan. 1, 1926. Illus. pp. 36-40. Equipment and requirements for burning wood waste.

**Higher Steam Pressures in the Industrial Plant. 658.26**

William F. Ryan. *Mechanical Engineering,* Jan. 1926, pp. 43-47. Outline of the gains from high pressure steam which are claimed to be greater for the industrial plant than for the central station.

**Boiler Room Tests. 658.261**

*Power Plant Engineering,* Jan. 1, 1926, pp. 81-87. Illus.

**Boiler Room Upkeep. 658.261**

*Power Plant Engineering,* Jan. 1, 1926, pp. 65-70. Illus. Important factors in the upkeep and maintenance of boilers, furnaces, superheaters and pumps.

**Refractory Maintenance in Boiler Furnaces. 658.262**

*Power Plant Engineering,* Jan. 1, 1926, pp. 70-73. Illus.

**Hand Firing for Power Boilers. 658.261**

*Power Plant Engineering,* Jan. 1, 1926. pp. 31-36. Illus. Determining factors for successful operation in hand firing.

**Stoker Operation by Modern Methods. 658.261**

*Power Plant Engineering*, Jan. 1, 1926. pp. 6-13. Illus. Proper methods for handling [illegible] grate [illegible]

**Good Firing Requires Intelligent Appreciation of Functions of Stokers. 658.26**

R. Sanford Riley. *Power Plant Engineering*, Jan. 1, 1926. pp. 2-5. Illus. Essentials of [illegible] 21 [illegible] 131 attention to fuel bed, air supply and ashpit [illegible]

**Operating Pulverized Fuel Equipment. 658.261**

*Power Plant Engineering*, Jan. 1, 1926. pp. 15-22. Illus. Suggestions for [illegible] various pieces of equipment in burning pulverized fuel.

**The Steam Engine as a Factor in Industrial Power. 658.26**

*Power*, Jan. 5, 1926. pp. 16-18. Illus. Investigation shows that the steam engine is holding its own as a prime mover in industrial power plants.

**Steam Control and Measurement. 658.26**

*Power Plant Engineering*, Jan. 1, 1926. pp. 78-79. Illus.

**Pneumatic Sweeping Systems in Power Plants. 658.261**

F. C. Allen, Jr. *Power Plant Engineering*, Jan. 15, 1926. pp. 147-8. Illus. Suction systems for sweeping power plants are desirable to reduce danger of dust explosions.

**District Heating Rates for Various Conditions. 658.217**

*Power Plant Engineering*, Jan. 15, 1926. pp. 155-7. Resume of rates for both steam and hot water from several companies and localities.

**Developments in Applying Electricity to Industrial Uses. 658.26**

*American Institute of Electrical Engineers Journal*, Dec. 1925. pp. 1312-8. Condensed [illegible] developments and engineering [illegible] tions during the past year.

**Electricity Operates the Marble Mill. 658.26**

F. A. Westbrook. *Electrical Record*, Oct. 1925. pp. 260-261. Equipment and methods of the Vermont Marble Co.

**Finding and Reducing the Wastes in Electric Power Distribution. 658.26**

A. G. Darling. *Industrial Management*, Dec. 1925. pp. 331-3. Illus. Power savings that are often overlooked in the modern plant.

**Using a Graphic Meter for Setting Overload Relays. 658.26**

G. A. Sharland. *Industrial Engineer*, Dec. 1925. pp. 564-6. Illus. Application of accelerating relays on controllers for motors, as made in the By-Products Coke Co. plant, with typical charts and methods of interpreting results.

**What Does Your Steam Contain? 658.26**

*Cement, Mill and Quarry*, Dec. 5, 1925. pp. 43-4, 46-8. Illus. Wet steam causes clogging of superheater tubes and erosion of turbine blades by carrying along impurities in water. Discussion of the losses thus caused, and [illegible]

### Power Transmission

**Power Transmission Efficiency. 658.262**

C. C. Hermann. *Belting, Transmission Tools and Supplies*, Dec. 1925. pp. 63-6. States that the point of efficient operation is not reached until every part of the entire drive is efficient.

**Motor Drives for Centrifugal Fans and Blowers. 621.34**

[illegible] *Power Plant Engineering*, Jan. 15, 1926. pp. 141-4. Illus. Characteristics of fans and blowers should be studied carefully in making selection of motors. Article shows such characteristics and gives basis for motor selection.

**Reducing the Friction Tax on Power Transmission. 658.262**

Allen F. Brewer. *Industrial Management*, Dec. 1925. pp. 370-5. Illus. Consideration of operating conditions; lubricating requirements; maintenance of lubrication; education of personnel.

## Marketing and Distribution

### Advertising

**Trade-Marking Cuts Out Useless Steps in Distribution. 608**

John Allen Murphy. *Printers Ink Monthly*, Jan. 1926. Illus. pp. 33-4. How Hercules Powder Company is proving the value of a trademark in simplifying marketing processes.

**Barometer of Machine Tool Orders. 658.808**

E. F. DuBrul. *Iron Age*, Jan. 14, 1925. pp. 134. Illus. Indicator of the National Machine Tool Builders' Association covering the period 1919 to date.

**Unfair Selling Prices. 658.808**

W. L. Churchill. MANUFACTURING INDUSTRIES, Feb. 1926. pp. 97-100. Shows how stockholders' investments in industrial properties are not earning in many cases a fair return. One reason is selling prices which do not have a sufficient profit margin.

**Analyzing Sales—Or Do You? 658.808**

Curtis E. Moss. *Printers Ink Monthly*, Jan. 1926. pp. 73-5. Illus. Details of system for analyzing sales used by the Planters Nut and Chocolate Co. One card gives complete customer-sales history.

**Preparing a Sales Manual and Making it Effective in Selling Work. Part I. 658.826**

R. C. Hay. *Printers Ink Monthly*, Jan. 1926. pp. 39-40, 91. Deals with the purpose of the manual and outlines what information it should contain

**The Courts Won't Always Let You Use Your Corporate Name. 659.1**

H. A. Toulmin, Jr. *Advertising and Selling Fortnightly*, Jan. 13, 1926. p. 23. Author states it is generally held improper for any concern to try to benefit from advertising done by another even in an entirely different field, or to cash in on the good will inherent in another's corporate name.

**When Is an Inquiry Not an Inquiry? 659.131**

G. Lynn Sumner. *Advertising and Selling Fortnightly*, Jan. 13, 1926. pp. 1920. Illus. Shows the returns from use of coupons and points out national advertisers use them to determine the results of their campaigns.

### Selling

**Bonus, Profit-Sharing, Point Systems, etc. 658.846**

Will Hunter Morgan. *Advertising and Selling Fortnightly*, Dec. 30, 1925. pp. 27, 62. Discussion of various plans for paying salesmen.

**Making the Plan Fit the Business. 658.8461**

Will Hunter Morgan. *Advertising and Selling Fortnightly*. Jan. 13, 1926. pp. 27, 54 Outline of a plan for paying salesmen including a [illegible] salary [illegible] and [illegible] expense [illegible]

**Salary-Bonus Keeps Salesmen on Their Toes. 658.8461**

Ross M. Dowd. *Printers Ink Monthly*, Jan. 1926. pp. 99-100. The compensation plan of the Utah Candy Factory.

### Packing, Shipping, Transportation

**Shipping Containers. 658.7884**

[illegible] New York. (Monograph No. 37). 139 pp. $1.25 Written for manufacturing plant use from the experiences and researches of the foremost authorities on shipping containers, such as the Freight Container Bureau of the American Railway Association, Container Testing Laboratories, etc. Shows how to obtain the most economical shipping container for each product. Describes what a shipping container should do; box and crate lumber; fastenings; crates; wood, fiber and strawboard boxes; wood barrels and drums; metal cans, barrels and drums; auxiliary packing and fastening; packing dangerous articles; packing for export; testing of containers.

**Commercial Aviation's Present Phase. 658.7885**

D. W. Douglas. *Society of Automotive Engineers Journal*, Jan. 1926. pp. 38-40. Lack of known factors in estimating costs, operating charges and maintenance expense is the present barrier to aviation progress. Author believes within two years the information will be available to determine profits from commercial aviation.

**Lessons of Six Year's Experience in Air Transport. 658.7885**

[illegible] Dec. 10, 1925. [illegible] The possibilities of economic operation of air [illegible]

**Car Service Aids Marketing. 658.7885**

[illegible] *Railway Age*, Jan. 16, 1926. pp. 145-149. Improved car distribution and more [illegible]

**Parts Anywhere in 24 Hours Under New Willys-Overland Plan. 658.877**

[illegible] *Automotive Industries*, Dec. 17, 1925. pp. 1013-1014. Illus. Maintenance [illegible] garages.

# Material Handling and Production Control

## Material Control

**Cutting Labor Costs 37 Per Cent. 658.281**

Chas. N. Underwood. MANUFACTURING INDUSTRIES, Feb. 1926, pp. 119-124. Methods used to determine bonus for loading freight cars from warehouse. The crew was reduced from 39 to 20 men.

**Keeping Materials Handling Costs Moving Downward in the Rubber Plant. 658.281**

Harold J. Payne. *Industrial Management*. Jan. 1926, pp. 40-43. Illus. General description of the use of electric trucks in a rubber plant.

**Simplified Production and Handling. 658.51**

H. H. Edge. MANUFACTURING INDUSTRIES. Feb. 1926, pp. 93-96. Illus. Describes the work of product classification of the Kelly Press Division of the American Type Founders Co. The two classes are round work and flat work, one production floor being assigned to each.

**Offsets for High Manufacturing Costs. 658.51**

Thomas D. Perry. MANUFACTURING INDUSTRIES, Feb. 1926, pp. 107-110. Illus. Influence of better production methods in offsetting the manufacturing cost effects of high priced materials and high wage rates.

**Buick Saves $3,500,000 in Nine Months. 658.532**

W. W. Clark, Jr. MANUFACTURING INDUSTRIES, Feb. 1926, pp. 85-8. Illus. The Buick Motor Co. is producing 1,000 cars a day with 5,000 fewer employees than in 1923. The author shows how this tremendous increase in production has been brought about and how expenses have been reduced.

**We "Paced" Every Process for Top-Speed Production. 658.542**

Milton Alden. *System*, Jan. 1926, pp. 54-56, 96, 98. Methods used by the Alden Manufacturing Co. to time schedule operations from the buying of raw materials to the collection of accounts receivable.

**Production Control in the Newsprint Industry. 658.561**

George D. Bearce. *Mechanical Engineering*, Jan. 1926, pp. 48-52. Outline of the manufacturing processes and production methods of a majority of the mills in North America making standard newsprint paper.

**Finding Causes of Quality Variations. 658.562**

W. A. Shewhart. MANUFACTURING INDUSTRIES, Feb. 1926, pp. 125-128. Illus. Shows how to determine whether variations in quality of product are due to non-assignable causes which cannot be overcome, or to differences from assignable causes which can be found and controlled.

**A Policy That Catches Errors Before Production Begins. 658.562**

B. J. Dowd. *American Machinist*, Dec. 17, 1925, pp. 975-976. Illus. Methods of checking and rechecking as practiced in the plant of the Royal Typewriter Co.

**Control of Inventory Through the Scientific Determination of Lot Sizes. 658.787**

H. S. Owen. *Industrial Management*, pp. 12-16. Illus. Fourth of a series of articles. This instalment deals with specifications for control records.

## Mechanical Handling

**When are Floor Transports Economical? 658.281**

H. Hellmich. *Engineering Progress*. Dec. 1925, pp. 377-8. Illus. Representative material handling equipment as installed in German factories.

**Hopper for Reloading in Remodeled Sand Plant. 658.281**

R. A. Goodwin. *Cement, Mill and Quarry*, Jan. 5, 1926, pp. 9-11. Illus. Material handling equipment at Kenosha Sand and Gravel Company's plant.

**Conveyor Belting in Santa Fe Elevator. 658.2812**

C. H. Compton. *Belting, Transmission, Tools and Supplies*, Jan. 1926, pp. 22-23. Illus. Conveyor equipment in second largest grain elevator in the United States. Belting installed approximately 3½ miles long.

**Surplus Sand Utilized Advantageously. 658.281**

E. D. Roberts. *Pit and Quarry*, Dec. 1, 1925, pp. 71-5. Illus. Handling methods at the Badger Sand and Gravel Co. plant.

# Employment and Personnel Management

## Employment and Training

**Products and By-Products of Foremen's Conferences. 658.386**

Franklin T. Jones. *Society of Automotive Engineers Journal*, Jan. 1926, pp. 60-66. Deals with the technique of introducing, conducting and auditing foreman training. Based on the experience of the White Motor Co. Means for deducing tangible results from the educational program are given in detail.

## Personnel

**The Human Factor. 658.3**

Published by the Massachusetts Society for Mental Hygiene, Inc. Four issues per year, 75c. Single copy, 20c. This publication is intended as an industrial service and according to its announcement is "a digest of the best that is being done in personnel work in business and industry." The initial number is made up of digests of current literature much of it applied to manufacturing operation. As an example we find these titles: Modern Ventilation Makes Possible Greater Comfort of Workers; Industrial Fatigue; Psychology Tests in Industry; Reduction in Industrial Accidents.

**Recent Development in Industrial Relations in the United States. 658.315**

Herbert Feis. *International Labour Review*, Dec. 1925, pp 776-798. Among the developments discussed are: Works Councils, of which 814 are analyzed, labor banks and managerial methods.

**Analyzing and Rebuilding Employee Attitudes. 658.315**

John F. Sherman. *Industrial Management*, Jan. 1926, pp. 19-25. Illus. General article on the relationship of employers and employees.

## Remuneration

**Wages and Hours of Labor. 658.32**

*Monthly Labor Review*, Dec. 1925, pp. 41-69.

**Various Wage-Systems in Relation to Factory Indirect Charges. 658.32**

R. R. Thompson. *N. A. C. A. Bulletin*, Dec. 15, 1925, pp. 283-296. Analysis of the elements of 8 wage payment systems: Halsey, Rowan, Barth, Bedeaux, Taylor, Gantt, Emerson and "ordinary piece rate." The author's conclusion is "a suitable bonus system will result in the necessary increase in production without any great increase in charges for power, indirect labor, supplies, etc.

**Real Wages Show Large Gain. 658.32**

*Iron Age*, Jan. 14, 1926, pp. 138-9. Common labor wage rates in iron and steel industry are 35 per cent higher in buying power than in 1913. Other classes of labor have had similar increases.

**They Share Profits with Their Labor. 658.324**

*Brick and Clay Record*, Jan. 5, 1926, pp. 44-49. Illus. Bonus method of the Ashland Fire Brick Co. together with other welfare plans including life insurance, methods for acquiring homes, and methods for loaning money.

**The Results of the Adoption of the Eight-Hour Day. 658.3811**

Edgard Milhaud. *International Labour Review*, Dec. 1925, pp. 820-853. An evaluation of the effect of the eight-hour day and technical progress based on information drawn largely from European countries.

## Health and Safety

**Maintaining Interest in Safety. 658.283**

C. B. Auel. *Gas Age-Record*, Jan. 2, 1926, pp 17-19, 20. Methods used in maintaining safety work in manufacturing concerns, and making sure of a continuous reduction in industrial accidents.

# Financial Control and Accounting

## Financial Control

**What Is Just Return on Funds Invested in Improvements? 657.372**

Warren D. Scudder. *Iron Trade Review*, Jan. 14, 1926. Author suggests that arbitrarily fixing a high rate of return on the investment from contemplated rehabilitation of plant and equipment may prevent the proper development of a manufacturing concern.

**Organization of the Functions of the Controller. 657.4**

Arthur Lowndes. *American Management Association*. Pamphlet, 16 pp.

**Analysis of Financial Statements. 658.14**

H. C. Guthmann. Prentice-Hall Inc. New York. 454 pp. $5. Serves the needs of bankers, credit men, investors, business executives and accountants. First part devoted to the general principles of the work of analysis: The true significance of funds and reserves, extraordinary adjustments, secured creditors, value of good-will, investments and other topics. Second part treats of particular types of statements under: Railroads, gas manufacturing corporations, power companies, individuals, mercantile companies, mines, banks, insurance companies and holding corporations. Chapter headings are: Place of financial statements in business; construction of the balance sheet; profit and loss statement; analysis of working capital; fixed assets and capitalization; interpreting balance sheet charges; analysis of income statement; interest and analysis by ratio studies; railroad statements; gas manufacturing corporations; hydro-electric power companies; mercantile and manufacturing corporation; mining statements; bank statement; insurance companies; holding companies reports.

**Analyzing Financial Statements. 658.14**

Stephen Gilman. Ronald Press Co. New York. 222 pp. $3.50. Takes the business manager's viewpoint throughout, rather than that of the accountant. Recommends the trend percentage method of analysis, which is a remarkably helpful innovation applying the index number method to financial statement analysis. Points analysis procedure consistently toward curing specific business ailments which commonly arise, another innovation in financial analysis. Covers: Field of statement analysis; balance sheets—single and comparative; specific business ailments; balance sheet ratios; historical analysis of balance sheets by ratio and by trend methods; standard ratios; profit and loss analysis; [illegible] methods of reports.

**Judging Organization and Personnel. 658.1**

Arthur Andersen. MANUFACTURING INDUSTRIES, Feb. 1926, pp. 113-117. Gives methods of analysis used in the financial and industrial investigation in order to evaluate the quality of the organization and the satisfactory nature of the personnel.

**Mathematics of Finance. 51**

Lloyd L. Smail. McGraw-Hill Book Co., Inc., New York. 310 pp. $5.00. This is a text intended for college classes, especially those in business administration or in commerce. It is based on one year's work in high school algebra. Arrangement of material is designed to give both flexibility and adaptability, and the styling of the pages is intended to aid these purposes. Material of a theoretical nature is printed in small type, all practical material in large type. The five parts are: Interest and Annuities Certain; Life Insurance; Subjects from Algebra; General Summary of Formulas; Tables.

**The Preparation and Administration of Budgets. 658.14**

Chester H. Wager. *N. A. C. A. Bulletin*, Jan. 2, 1926, pp. 327-340.

**Principles and Scope of Budgeting. 658.14**

Percy Bowen. *American Management Association*, New York. Pamphlet, 16 pp.

**Budgeting to the Business Cycle. 658.14**

James H. Rogers. Ronald Press Co. New York. (Monograph No. 38). 115 pp. $1.25. Written to apply the pre-vision of business trends, and the financial, production, plant and personnel facilities of a manufacturing business, to effective budgetary planning for an individual concern. Explains the method of forecasting sales from a thorough pre-analysis of external and internal conditions and trends, and the co-ordinating of production with these sales possibilities. Based on actual successful methods used by the Walworth Co. and checked for a long period against actual performance. Outlines the prime difficulty in budgetary control; problem of harmonizing budget and trends; cycle analysis of a particular business; comparative predictions from underlying trends; quantitative predictions of an industry's trend.

**Successful Budget Installation. 658.14**

Chas. F. Thiry. MANUFACTURING INDUSTRIES, Feb. 1926, pp. 89-92. Illus. Performance and results of the operation of the budget system covering all departments of a textile manufacturing plant.

**Budgeting Practices and Experiences of the General Electric Company. 658.14**

Frank B. Cleveland. *American Management Association*, New York. Pamphlet, 12 pp.

**Budgeting Financial Requirements. 658.14**

R. V. C. Heath. *American Management Association*, New York. Pamphlet, 8 pp.

**Payroll Budgeting. 658.14**

Chester P. Grassmuck. *American Management Association*, New York. Pamphlet, 12 pp.

**National Association of Cost Accountants Year Book—1925. 657**

National Association of Cost Accountants, New York. 205 pp. Complete record of the Sixth International Cost Conference held at the Statler Hotel, Detroit, June 15 to 18, 1925. This volume should find a place with its predecessors in any library which includes progressive literature of the cost accounting [illegible].

**Depreciation, Obsolescence, Depletion. 657.42**

G. W. Greene. *Textile World*, Dec. 22, 1925, pp. 935-936. Simple methods of handling these three items in the brick and clay field.

**Mill Cost Methods. 657.452**

[illegible]. *Paper Trade Journal*, Dec. 24, 1925, pp. 53-55. Classification of paper mill accounts as used by the S. D. Warren Co. Cumberland Mills.

**The Financial Responsibility of the Foreman. 657.452**

J. Eigelberner. *American Machinist*, December 17, 1925, pp. 963-965. Cost accounting is based upon original records for many of which the foreman is responsible. These must be accurate if costs are to be dependable. Methods are given whereby the foreman can discharge this responsibility.

**Valuation of Intangibles—III. 657.42**

Herbert M. Rogers. *Journal of Electricity, Power*, Oct. 1925, pp. 60, 62, 84. Taxes and interest during construction, incidentals, omissions, contingencies. IV—Nov. 1925, pp. 94, 112, 116, 122, 124. General contractor's profit, fixed charges on inactive plant, going concern value. V—Dec. 1925, pp. 90, 92, 94, 96, 98, 100. Going concern value must be allowed; going concern value in purchase cases; court decisions.

**Financial Handbook. 658.14**

Edited by R. H. Montgomery. The Ronald Press Co., New York. 1749 pp. $7.50. This handbook is the third to be issued by its publishers in a period of two years. It is intended for constant reference by all who have in any way to do with the financing of a business. Thus it provides for ready use and in sufficient detail usable information on all questions which are likely to arise in the financial management of business organizations whether large or small. It is intended for all executives who have to deal with financial problems as well as specifically for the financial manager or treasurer. Thus its scope covers the financial aspects and relationships, both external and internal, that make up the general financial management of a business. It presents [illegible]. The [illegible] to be accepted for handbooks has been followed, namely, the subdivision of the general subject into a series of sections, and the selection of a group of special contributors. The volume contains 34 sections by 24 special contributors, and acknowledgment is made to 8 collaborators. The scope of the handbook is indicated by the section headings: Fundamentals of business economics; mathematics of finance; financial statements and reports; budgets; control of current operation; business law; capital structure and policies; fixed capital expenditures; purchasing; insurance protection; types of business organizations; controlling inventory investment; security markets; "blue sky" laws; export and import procedure; foreign exchange and finance; [illegible]; treasurer-comptroller-secretary their functions, etc.; banks and their uses; profit-sharing; [illegible]; termination; federal regulation of business; [illegible]; controlling sales and sales expense; fiduciary [illegible]; terms; abbreviations of business terms.

# News of Manufacturing Industries

## The Month in Brief

**Allis-Chalmers Manufacturing Company** reports unfilled business at close of 1925 totalled approximately $10,150,000.

**American Electric Corporation** has been formed under the laws of Delaware to acquire the entire business and assets of the Belding-Hall Company and patent licenses for an electrical refrigerating machine. Arthur E. Swanson, formerly Vice President of the American Radiator Company will become identified with the management. The company's plants are located at Belding, Mich.

**A. P. W. Paper Company** has sold 15,000 shares 7 per cent cumulative preferred stock par value $100 and 30,000 shares common stock of no par value. The proceeds will be used to retire the outstanding funded debt and to furnish additional working capital.

**Baldwin Locomotive Works** shipped during 1925 a total of 724 locomotives divided as follows:

| | Domestic | Foreign | Total |
|---|---|---|---|
| Steam | 358 | 234 | 593 |
| Electric | 97 | 32 | 129 |
| Gasoline | 1 | 2 | 3 |

President S. M. Vauclain expects to be running the plants at 75 per cent capacity by July 1; orders on the books as of January 1, 1926, total over $7,000,000.

**Bayless Pulp and Paper Company.** The Mead Investment Company has purchased the Canadian properties of the Bayless Pulp and Paper Company. The tract includes 350 square miles of the St. Anne River watershed. A new paper mill is to be erected at Beaupre, near Quebec.

**Beacon Oil Company** purposes to offer 160,000 additional shares of common stock to its common stockholders at $25 per share. After this subscription of new stock it is proposed to distribute a 100 per cent stock dividend to the common stockholders.

**B. F. Goodrich Company** has sold $15,000,000 5 per cent serial gold notes, proceeds to provide additional working capital which it seems advisable for the company to have at this time because of the present abnormal cost of crude rubber.

**J. J. Brill Company** has submitted a plan to the stockholders of the J. J. Brill Company providing for the acquisition by a new corporation to be known as "The Brill Corp." of all or at least 60 per cent of each class of the present company's outstanding capital stock, and more than 50 per cent of the preferred, and approximately 67 per cent of the common stock of the American Car and Foundry Motors Company. The last named company owns all the capital stock of the Hall-Scott Motor Car Company (of California) and more than 90 per cent of the capital stock of Fageol Motors of Ohio. The object of the plan and reorganization is to take advantage of the growing motor bus business in conjunction with the present car business. The Hall-Scott Motor Car Company manufactures and markets gasoline motors used in motor busses, trucks, airplanes and as marine equipment. The Fageol Motors Company manufactures and markets the "Fageol" bus.

**Brown Hoisting Machinery Company** has disposed of $1,250,000, first mortgage 6 per cent serial gold bonds. The proceeds are for the purpose of providing the company with additional working capital to enable it to push vigorously the sale of its standard line and several new products about to be placed on the market The company designs and manufactures hoisting and conveying appliances and heavy material handling machinery. Much of its product goes to railroads, public utility companies, and steel mills.

**Carborundum Company** authorized capital stock has been increased by the stockholders from $7,000,000 to $10,000,000. Additional stock is to be distributed as a stock dividend, payable out of accumulated surplus.

**C. G. Spring and Bumper Company** has declared a regular quarterly dividend of 10 cents a share on the common stock, payable February 15. Also an extra dividend of 5 cents per share was declared payable with the regular dividend.

**Continental Can Company** has declared an extra dividend of $1.00 per share, and a regular quarterly dividend of $1.25 per share on the outstanding common stock. From August 15, 1923, to November 16, 1925, inclusive, the company paid quarterly cash dividends of $1.00 per share on the common stock, on February 15, 1924, and February 16, 1925, it also paid 5 per cent on the common stock.

**Crane Company.**—Over 3,800 employes who have served the company 10 years or longer have been made stockholders under a Christmas gift. One share of common stock will be distributed for each year of service, the distribution coming from the personal holdings of R. T. Crane, Jr., president, and not from the company.

**Crown Willamette Paper Company** has sold 200,000 shares, no par value, first preferred stock entitled to cumulative dividends of $7.00 per share per annum.

**Dodge Brothers, Inc.**—A total of 24,116 trucks was shipped by Graham Bros. unit of Dodge Bros., Inc., during 1925 from the four plants in Detroit, Mich.; Evansville, Ind.; Stockton, Calif.; and Toronto, Ontario. This is an increase of 125 per cent over the corresponding output for 1924. A total of 235,782 passenger and commercial cars were shipped by Dodge Bros. during 1925. This number exceeded dealers' preliminary orders by approximately 30,000 cars.

**Dodge Manufacturing Corporation** has sold to the American Foundry and Equipment Company an idle plant of about 65,000 sq. ft. floor area.

**Eagle and Phenix Mills** has increased its common stock effective January 1, 1926, by issuance of 5,000 shares par value $100 of 6 per cent cumulative preferred stock. The proceeds are to be used to pay off $500,000 5 per cent bonds due January 1, 1926.

**Fairbanks-Morse Company** has declared the regularly quarterly dividend of 1¾ per cent on the preferred stock, payable March 1.

**Fisk Rubber Company,** one of the five largest manufacturers of pneumatic and solid motor vehicle tires, having a plant with a daily capacity of 30,000 cases and 50,000 inner tubes, has recently offered an issue of $10,000,000 5-year 5½ per cent sinking fund gold notes.

**Ford Motor Company.**—A total of 2,103,588 cars, trucks, tractors and airplanes was produced by the Ford Motor Company in 1925. This represents an increase of 20,033 units over the 1924 record exclusive of airplanes.

**General Motors Corporation.—A total** of 835,749 cars and trucks by the various divisions of the General Motors Corporation to its dealers is the preliminary figure for 1925. The corresponding figure for 1924 was 587,341, an increase of 255,508.

The corporation announced on January 22 the disbursement of $11,200,000 in cash and common stock to its 8,300 employes. The actual cash distribution to be made to employes of the "1920 class" from the corporation's savings fund is $2,043,405. This is their deposits in the fund, plus interest at 6 per cent., compounded semi-annually. In addition to this cash there is being distributed from the investment fund 75,481

*(Continued on page 138)*

"We never know how *little* we make (or save), until we know how *much* we *WASTE*"

# CAN YOU INCREASE YOUR PLANT EFFECTIVENESS IN 1926?

**Yes!** Through locating, appraising, and eliminating **industrial wastes!**

President Coolidge, in addressing the New York Chamber of Commerce, New York, November 19, 1925, regarding what should be done in the future, said—

> ". . . we need still further effort against all the categories of waste which the Department of Commerce has enumerated and so actively attacked, for in this direction lies not only increased economic progress, but the maintenance of that progress against foreign competition. There is still plenty of work for business to do."

Why is there still plenty of work for business to do?

Because it is estimated that waste in this country causes an **economic loss** in our national effort, in our man-power, **of from 30% to 50%**, according to the following authorities—

> A. "Secretary Hoover, the first speaker, said that waste amounted to fully 30% of our national effort."—New York Times, April 12, 1925.
>
> B. Stuart Chase, in "The Tragedy of Waste"—"Half and more of our man-power counting for nothing; half and more of the yearly output of national resources needlessly scattered and destroyed . . ."

On the basis of an average of 40% in waste, the effectiveness of our industrial machine, of industry as one composite plant, **IS ONLY 60%.**

This means that the productivity of this composite plant **can be increased two-thirds.**

**This great plant being the aggregate of all the business enterprises of the country, the REAL issue becomes this—To what extent does each business vary from this average waste factor of 40%? Can an industrial executive rest content, and does he best serve his stockholders, his employees, and his trade, until he KNOWS?**

The job of WASTE ELIMINATORS, INCORPORATED, is to "assist" the busy industrial executive and his associated executives, in determining, diagnosing, evaluating and eliminating waste. It works on the principle of engineer and scientist and economist cooperating with employer and worker; it operates on the basis of a retainer, plus a division of the savings made, between client being served, his employees who assist in effecting savings, and WASTE ELIMINATORS, INCORPORATED.

We survey and evaluate, make researches, standardize and simplify, and supervise and counsel. We concern ourselves primarily with products, plant, equipment, operations, and materials, and the utilization and coordination of all of these to economic ends. We cover waste elimination from raw material operations, through fabrication and distribution, to ultimate use of products by consumers.

WASTE ELIMINATORS, INCORPORATED, has the sincere belief that a **real opportunity** exists in American Industry, for "increasing the margin" to Capital, Management and Labor, by eliminating waste, and to this end offers its services to industrial executives who see in this great work the answer to many of their pressing problems, against which we can match men, methods, training and experience, and time to study these problems.

**Correspondence is invited from all such executives, and the submission of pressing problems will be appreciated, all of which will be held in the strictest confidence.**

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INCORPORATED

C. E. KNOEPPEL, *Managing Director*

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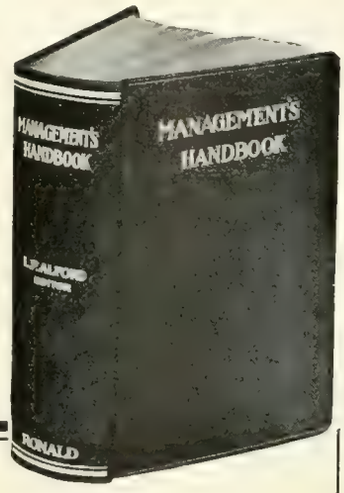


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Cost Accounting—Banking Relations—Simplification and Standardization—Packing for Shipment—Tables and Statistics—The Industrial Plant—Forms—Economic Principles—Organization of Ownership—Information Filing System—Insurance.

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shares of General Motors Common stock, which has a market value of about $9,157,720. The checks and stock go to fifty-five cities, where the corporation has plants and branches.

During each year since the establishment of the savings fund in 1919 a new class has been formed, maturing in five years. In the course of the year employes make monthly or semi-monthly payments into the savings fund, not to exceed 10 per cent of their wages, and the total for the year must not exceed $300. For each dollar put into the savings fund by employes the corporation puts 50 cents into an investment fund in the subsequent five years. Employes have the right to withdraw their deposits, plus interest, but if they withdraw before the end of five years they forfeit the money deposited by the corporation.

Any employe participating may borrow money to make payment for a home without losing the benefits of the plan. Of the 8,300 employes in the 1920 class approximately 4,000 are buying homes through the aid of the fund. At the present time 54 per cent. of all eligible employes, or 36,000, are participating under the plan.

**General Tire and Rubber Company.**—A net profit of over $44 per share on the common stock is reported for the year ending November 30, 1925, the amount being $1,843,299 after deducting federal taxes. The comparable figures for the preceding year were $1,500,000 or over $37 per share of common stock.

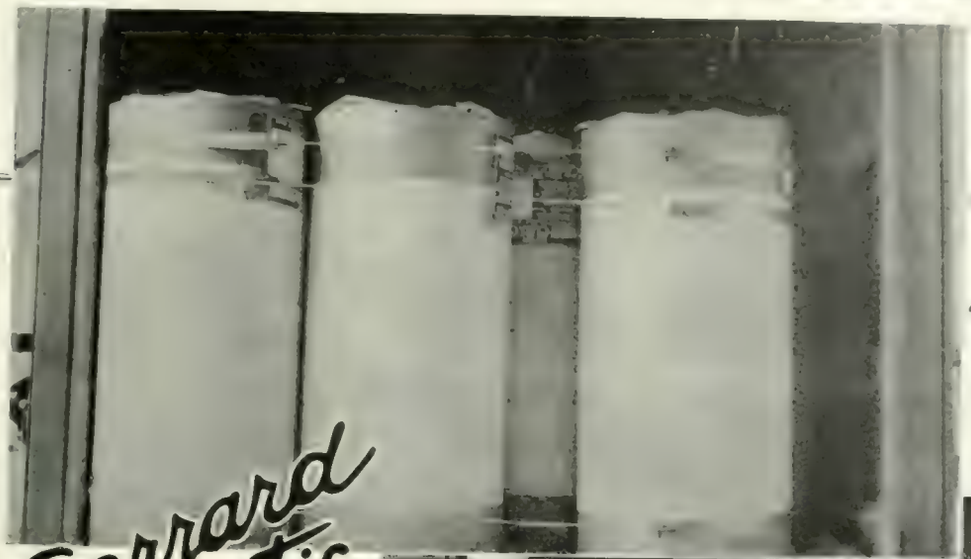
**Gillette Safety Razor Company** has declared an extra dividend of 25 cents per share in addition to the regular quarterly dividend of 75 cents per share on the outstanding capital stock payable March 1. Like amounts were paid September 1 and December 1, 1925. On March 2, and June 1, 1925, extra dividends of 12½ cents were paid in addition to the quarterly dividends of 62½ cents per share.

**Glidden Company** reports net profit for 1925 as $1,709,361. This is an increase over two preceding years in which the net profits, respectively, were $1,078,906 and $1,116,502.

**Gonic Manufacturing Company.**—It has been announced that the Gonic Manufacturing Company has put into effect a reduction of 10 per cent in wages. This concern, which produces woolen goods, has recently resumed operations after several months of idleness.

**Goodyear Tire and Rubber Company.**—The Essex Cotton Mills, Brighton Avenue, Passaic, N. J., are about to pass into the control of the Goodyear Tire and Rubber Company. The company manufactures cotton fabric for use in automobile tires, and its plants were greatly extended during the war.

*(Continued on page 140)*



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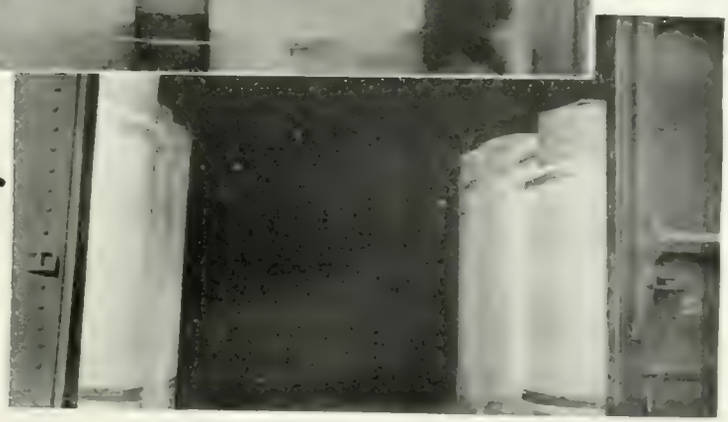
"The Tie That Binds"

# Gerrard Uni-Lastic Stowage



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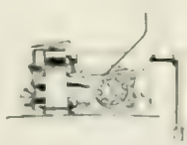

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**Gotham Silk Company, Inc.**—From October 17 to December 31, 1925, 176,000 dozen hosiery were shipped as against 124,000 dozen for the same period in 1924. The estimated output of 550,000 dozen for the year was exceeded.

**Harbison-Walker Refractories Company.**—An extra cash dividend of 2 per cent on the outstanding common stock was declared, payable January 20. The same dividend was paid on January 31, 1925; a 33⅓ per cent stock dividend on the common stock was paid on May 19, 1925. Also the regular quarterly dividend of 1½ per cent on the common stock, payable March 1, has been declared and the regular quarterly dividend of 1½ per cent on the preferred stock, payable April 20.

**Hood Rubber Company** proposes to create a new preferred stock which will carry cumulative dividends at the rate of 7½ per cent per annum payable quarterly, entitled to be paid 107½ per cent in case of liquidation or call.

**Ingersoll-Rand Company** has declared an initial dividend of 75 cents per share on the new common stock, placing it on a $3 annual basis. The dividend is payable March 1.

**Kellogg Switchboard Signal Company** has declared an extra dividend of 12½ cents per share in addition to the regular quarterly dividend of 50 cents per share.

**Lee Rubber and Tire Company** is offering to stockholders an opportunity to subscribe for 85,163 shares of additional capital stock at $12.50 per share, on the basis of two-fifths of a new share for each share now held. Proceeds from the sale, approximately $1,000,000, will be used to reduce outstanding bank indebtedness. Earnings for 1925 with final month partly estimated, but after taxes, interest and depreciation were deducted were $248,538. This is equal to $1.32 per share on the outstanding capital stock. Corresponding result for previous year was net deficit of $234,473.

**Liggett & Myers Company** earned in 1925 the largest net profit of any year in the history of this company, the total being $17,028,475, compared with $13,714,197 in 1924. The income statement for the past three years is:

| | 1925 | 1924 | 1923 |
|---|---|---|---|
| Net profit | $17,028,475 | $13,714,197 | $11,375,627 |
| Deduct | 26,178 | 23,621 | 23,593 |
| Interest | 1,712,645 | 1,720,747 | 1,729,637 |
| Net income | $15,289,652 | $11,969,829 | $ 9,622,397 |
| Preferred dividends | 1,575,987 | 1,575,987 | 1,575,987 |
| Common dividends | 7,886,995 | 4,898,455 | 4,038,993 |
| Surplus | $ 5,827,270 | $ 5,495,387 | $ 4,007,417 |
| Previous surplus | 40,459,544 | 34,964,157 | 30,956,740 |
| Profit and loss surplus | $46,286,814 | $40,459,544 | $34,964,157 |

**Mack Trucks, Inc.**—Common stockholders of record January 22 were given

*(Continued on page 142)*

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# (2) *Keeping down inventories—*
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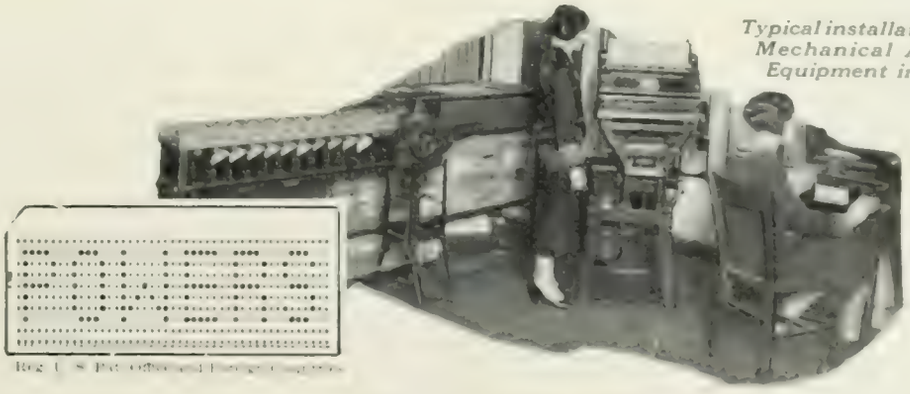

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the right to subscribe on or before February 11 to 101,919 additional shares no par value at $100 per share on the basis of one new share for each share owned. The officers forecast a material increase of business and profits, if plant capacity and working capital are provided. The construction authorized by the directors within the last year to enlarge the plants will near completion during 1926. The International Motor Company, a subsidiary of Mack Trucks, Inc., has purchased the Niles-Bement-Pond plant at Plainfield, N. J., as one step in the expansion program.

**Moore Drop Forging Company.**—An initial dividend of $4 per share on the Class "B" stock, no par value, has been declared. This, together with the regularly quarterly dividend of $1.50 per share on the Class "A," is payable February 1.

**Munsingwear, Inc.** reports net income for year ending November 30, 1925, as $939,010. This compares with $487,374 for the corresponding period ending November 30, 1924.

**Nash Motors Company** stockholders have approved the distribution of a 900 per cent stock dividend on the outstanding common stock. C. W. Nash, president, states that it is the hope of the management that earnings will permit the continuation of the same amount of dividends on the new stock which will be at the rate of $2 per share per annum, the equivalent of the present rate of $20 per share per annum for the old stock. A cash dividend of $10 per share on the common stock, payable February 1, has been declared. On August 1, 1925, the company paid an extra dividend of $6.50 per share on the common stock in addition to the regular semi-annual dividend of $3.50 per share.

**Nashua Manufacturing Company.**—Operation for the year ending October 31, 1925, showed a loss of $154,852, the corresponding loss for the year ending October 31, 1924, $716,010. The surplus as of October 31, 1925, is $5,769,516. The corresponding surplus as of October 31, 1924, was $6,140,680.

**National Cash Register Company** has just sold 1,000,000 shares of common (A) stock of the company. These shares are on a $3 annual dividend basis and are priced at $50 each. With the public sale of this stock the employes profit-sharing plan heretofore in effect has been discontinued, instead 150,000 fully paid shares, 37½ per cent of the total, of common (B) stock have been set aside for employes.

**Phoenix Iron Works Company.**—Meadville and Pittsburgh interests bid in at a receivership sale on December 11, the real estate, equipment and plant of the Phoenix Iron Works Company. It is expected that operation will be resumed.

*(Continued on page 145)*

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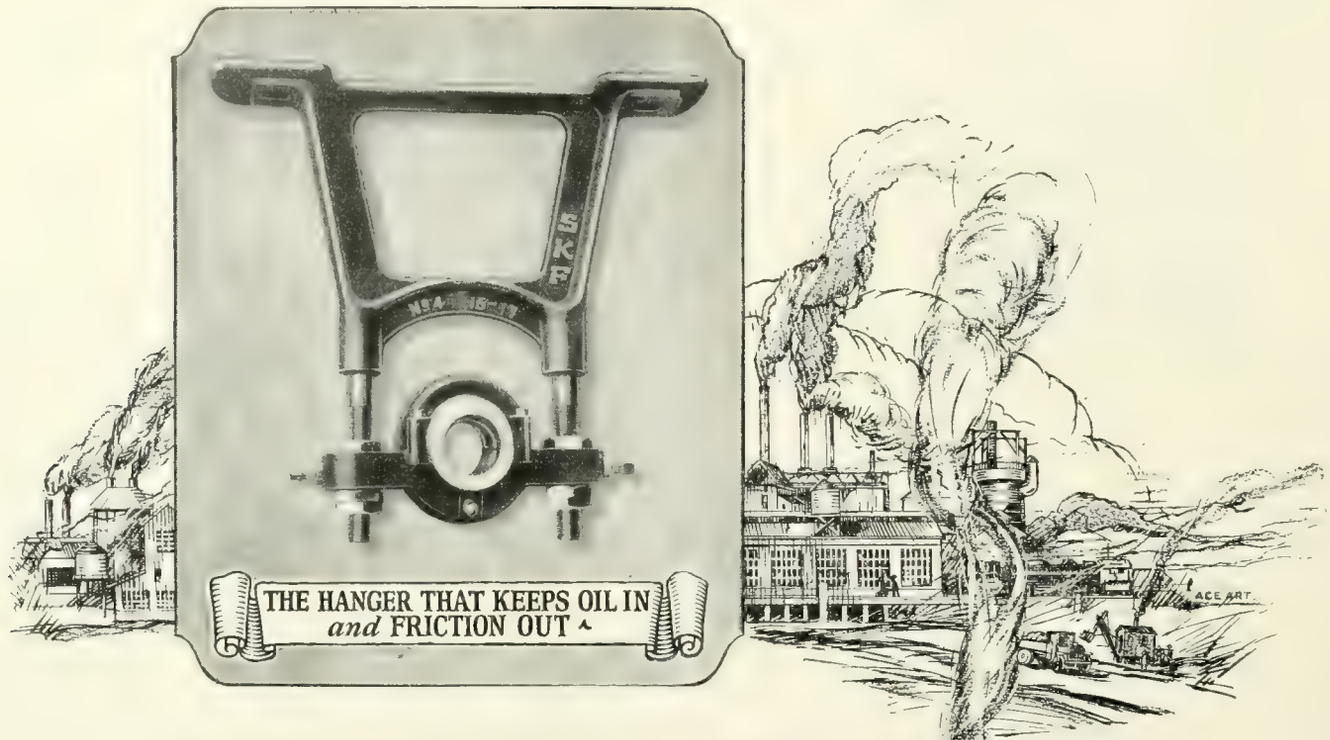
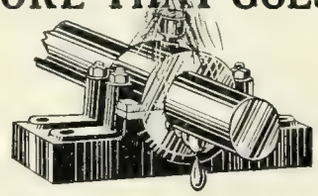



# TWO KINDS OF WASTE

## SMOKE THAT GOES UP



## OIL THAT COMES DOWN

FRICTION plays a dual role in many plants where line shafting turns on plain bearings. For not only is there a waste in power, oil, lubricants and labor costs, but often there is the greater waste caused by oil that drips from overhead and damages valuable merchandise.

A Pennsylvania mill devoted to the weaving of heavy fabrics, facing these conditions, installed Skayef Self-Aligning Ball Bearing Hangers. The result was not only a reduction in maintenance costs to a point where the saving represented 49% of the cost of the Skayef installation, but the oil-tight Skayef bearings eliminated all oil spoilage in the plant.

Just another instance where a Skayef installation paid for itself in less than two years' time. Why not put YOUR hanger problems up to SKF?

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# SKAYEF HANGERS

**POST HANGERS, PILLOW BLOCKS AND TRANSMISSION APPLIANCES**

SKF Puts the Right Bearing in the Right Place

**Postum Cereal Company** has declared a quarterly dividend of $1.10 per share on the outstanding capital stock payable February 1. From February 1, 1924, to November 1, 1925, the company paid quarterly dividends of $1.00 per share on its common stock besides the issuance to stockholders last November of two new shares of no par value stock, in exchange for each share held, and before the issuance last December of 570,000 shares of Postum stock in exchange for all the outstanding capital stock of the Jell-O Company, Inc.

**Procter & Gamble Company** has declared the regular quarterly dividend of $1.25 per share on the common stock, payable February 15.

**Rand Kardex Bureau, Inc.** has taken over the Globe-Wernicke Company, one of the largest and oldest manufacturers of office equipment in the country. According to James H. Rand, Jr., president of the Rand Kardex Bureau, Inc., this consolidation now becomes the largest distributor of business equipment in the world, both in sales volume and number of employes. It is estimated that the combined sales volume of the consolidated companies will exceed $40,000,000 annually. It is also reported that the Rand-Kardex Bureau, Inc., has concluded arrangements for alliance with the Safe Cabinet Company of Marietta, Ohio, makers of fireproof cabinets.

**Republic Iron and Steel Company** reports for the final quarter of 1925 earnings aggregating $1,200,000 available for dividends. This compares with $846,461 available for dividends in the September quarter. The estimated earnings for the December quarter of the year 1925 compared with other periods is:

| | | | |
|---|---|---|---|
| | Dec. 31, '25 | Sept. 30, '25 | Dec. 31, '24 |
| Net [illegible] | $1,200,000 | $846,461 | $152,932 |
| Preferred [illegible] | | | |
| Dividends | 437,500 | 437,500 | 437,500 |
| Surplus | $ 762,500 | $408,961 | * $284,568 |

* Deficit

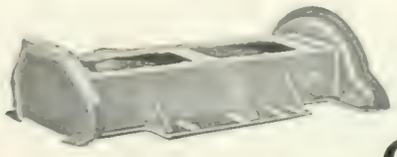
**Smith and Corona Typewriters, Inc.,** declared an initial quarterly dividend of $1.75 per share on the preferred stock, payable February 1.

**Stewart Warner Speedometer Corporation** declared a quarterly dividend of $1.50 per share, placing the capital stock on $6 annual basis, dividends payable February 15. During 1925 the company paid quarterly dividends of $1.25 per share and an extra dividend of $1.00, making the total $6 for the past year.

**Superior Steel Corporation** showed net earnings of $100,000 for 1925, equivalent to $1 per share of stock.

**Swift and Company** reports net earnings for the year ending October 31, 1925, with deductions for interest, and depreciation as $15,379,152. The corresponding period as of October 31, 1924, is $14,125,899.

(Continued on page 126)

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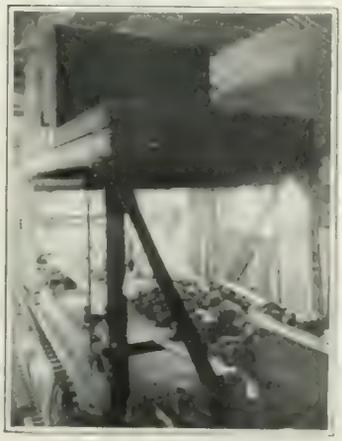

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| CEMENT | SAND |
| SHALE | PAPER MILL PRODUCTS |
| CLINKER | HOG FUEL |
| ROCK | SALT |
| GYPSUM | ETC., ETC. |
| FISH | |

MERRICK SCALE MANUFACTURING CO.

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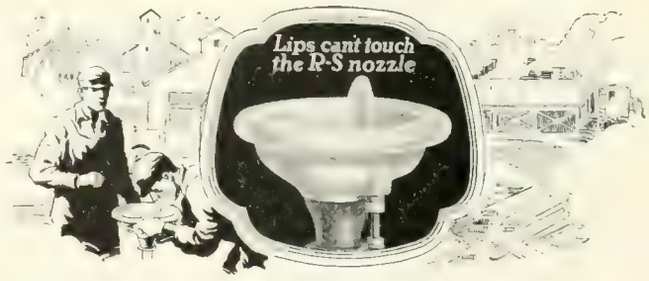


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YOUR employees do their best—when invigorated with plenty of clear, fresh water from Rundle-Spence Vertico-Slant Fountains. They stay on the job, take less time out and do a **full day's work.**

No chance for contamination to creep in, because **lips can't touch the R-S nozzle.**

The slight slant stream prevents water from falling back upon the jet. It's a "health bubbler" straight through.

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To date, an aggregate of nearly one hundred million horsepower have been equipped with Elesco Superheaters in America alone. These include superheaters for all purposes. By consistently giving dependable and efficient service, these installations have resulted in an increased demand on the part of leading central stations and industrial plants for Elesco Superheaters.

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Boston Pittsburgh

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**Truscon Steel Company.**—Net earnings for the year ending December 31, 1925, are announced as equivalent to between 35 and 38 per cent of the common stock of the combined Truscon Companies, after deductions for depreciation, federal taxes and dividend requirements on preferred stock.

**United Clay Products Corporation.**—This new corporation is a merger of 28 brick and tile companies located in Iowa, Kansas, Missouri and Oklahoma. It will own 32 manufacturing units which combined have been doing an annual gross business in excess of $4,200,000. The products include common brick, face brick, paving brick, hollow tile and drain tile. The plant will have combined capacity in excess of 500,000,000 bricks annually. It is expected that the corporation will add to its line of product by manufacturing roofing tile and other clay products.

**United States Rubber Company.**—The addition of 5,700 acres, or approximately 9 square miles of land for rubber plantations has been acquired in Sumatra. This brings the total holding of rubber plantation lands of the company up to 124,014 acres, representing an investment of approximately $25,000,000. In 1925 the company's plantations yielded approximately 20,000,000 lbs. of rubber. By 1931 it is estimated that production will have increased 75 per cent due to the planting of new areas and the maturity of trees already in bearing or about to approach the bearing stage.

**United States Steel Corporation.**—Announcement is made that this company will give employes the privilege of subscribing to 100,000 shares of common stock at $136 per share. The terms are the same as those which have prevailed in preceding years, employes being allowed to pay for the stock in monthly instalments. This subscription price is the highest which has ever been fixed, the price for preceding years having been $125 in 1925, $100 in 1924, $107 in 1923, $84 in 1922, $81 in 1921, $106 in 1920 $92 in 1919 and 1918, $107 in 1917 and $85 in 1916. In 1921 employes took a total of 255,325 shares.

**Vereingte Stahlwerke Aktien-Gesellschaft.**—It is announced that a combination of German steel manufacturing concerns has been completed, producing an organization comparable with the Bethlehem Steel Company in size and variety of products. The fused concerns are: Rheine-Elbe Union, Deutsche-Luxemburg, Gelsenkirchen, Bochum, Thyssen, Phoenix and Rhenish Steel. The consolidation's annual production at full capacity will be 30,000,000 tons of coal, 8,000,000 tons of coke 2,500,000 tons of pig iron, 3,700,000 tons of steel. In Germany this consolidation is welcomed on the ground that it marks a restoration of the horizontal trust principle as compared with the vertical trust principle which has been so popular during the past few years.

# Construction and Equipment *for* The Modern Plant

IN 1925 the total amount of industrial construction started in the 36 eastern states was $462,741,000, according to F. W. Dodge Corporation compilations. The estimated total for 1926 for the entire country is $483,392,500 as prepared by the *Architectural Forum*.

Into these new manufacturing buildings is going the best of design and construction, most economic materials, improved machinery and most efficient equipment. The determination behind their selection is to produce a maximum profit.

The materials, construction and equipment indexed below and advertised in the following pages are being installed in modern manufacturing plants which are striving for improved operation and lower costs.


PAGE

Buildings
Stone & Webster . . . . . 148

Industrial Trucks
Marion Tool Works . . . . . 150
Mercury Manufacturing Company . . . . . 152

Instruments, Recording
Taylor Instrument Company . . . . . 153

Lineshaft Bearings
Hyatt Roller Bearing Company . . . . . 154

Time Recorders
Calculagraph Company . . . . . 151

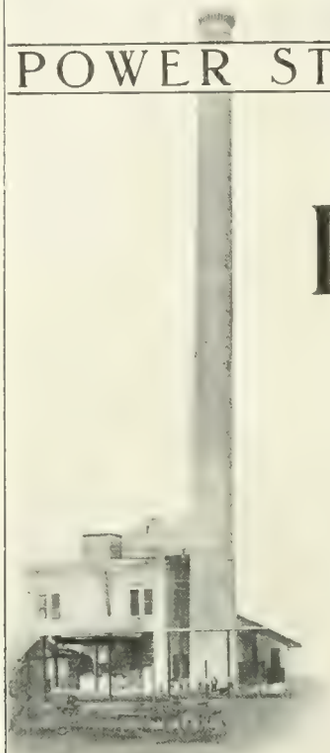
Valves
Jenkins Brothers . . . . . 150

Ventilating, Heating and Power Equipment
B. F. Sturtevant Company . . . . . 149

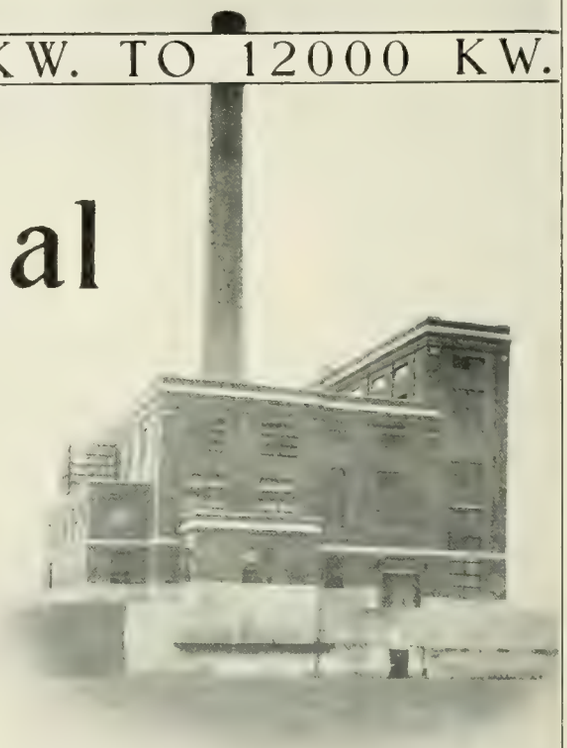
Wire Glass
Mississippi Wire Glass . . . . . 150

POWER STATIONS 500 KW. TO 12000 KW.

# Industrial Power



MERRIMAC CHEMICAL CO.
(500 KW.)



PITTSBURGH PLATE GLASS COMPANY
(12000 KW.)

BOILER PLANTS 700 B. H. P. TO 6000 B. H. P.

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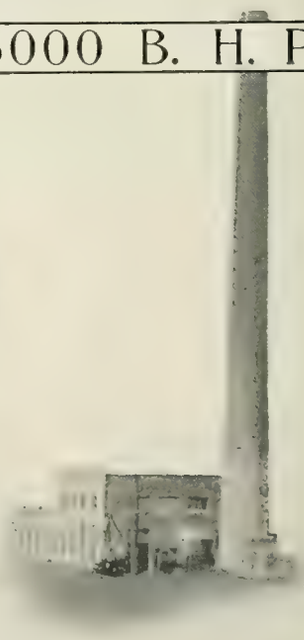

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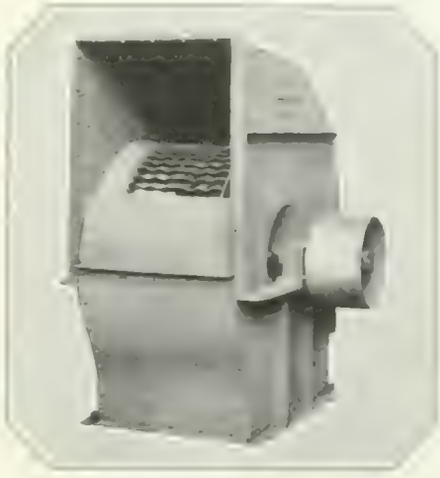
# Sturtevant Equipment at Kearny Plant of Western Electric Co.

Because of its known dependability, fine construction and modern design, Sturtevant Apparatus was selected for the new Kearny Plant of the Western Electric Company.

In this modern factory five Multivane Fans and three Sturtevant Portable Ventilating Sets are meeting all ventilating requirements. Five Sturtevant Slow Speed Exhausters are used for collecting and conveying purposes.

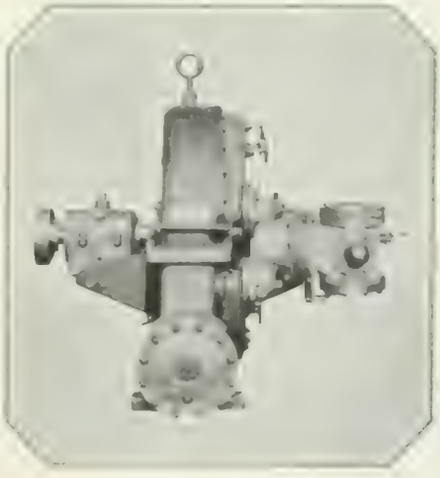


*Sturtevant Multivane Fan*

In the power plant, four Sturtevant Turbovane Fans are supplying forced draft to the boilers. Two Sturtevant Turbines driving boiler feed pumps, and two driving fire pumps, are also installed here. Each turbine has a specially built steel casing to resist high steam pressure and is operating under 275 lbs. pressure and 200° super heat.

In passing we might mention that this company recently placed an order for three Sturtevant Moist Air Fan Kilns to dry the lumber used in the manufacture of its various products.

Our engineers will be pleased to suggest the most suitable type of equipment for *your* particular needs.



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Sturtevant
PUTS AIR TO WORK

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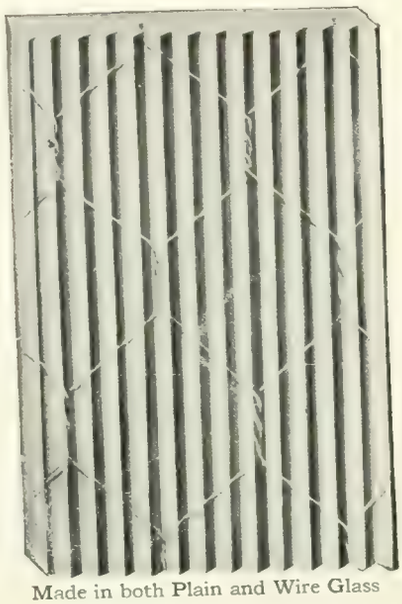
# PENTECOR WIRE GLASS



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For skylights, this is the best type of glass to install, because it is scientifically designed especially for skylights to conduct condensation and transmit the maximum amount of daylight.

There is no glass which will give better light distribution in skylights than Pentecor. It is no more expensive than Rough or Ribbed, so why not get the best and reduce the cost of artificial illumination?

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# Old standbys

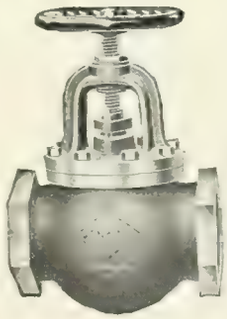

*Fig. 142*

*Flanged, Jenkins Standard Iron Body Globe Valve.*

Jenkins Valves are old standbys with veteran engineers who buy on the basis of known performance. These men have learned from experience that a policy of standardizing on valves marked with the Jenkins "Diamond" puts an end to expensive repairs and frequent replacements.

"Made to Jenkins standards" means made to give maximum service, not merely the average. Valves with this reserve strength are sure to be the "old standbys" of the future.

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**Marion - - - - Indiana**

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# Elapsed Time

"Elapsed Time" is the exact time spent on any given piece of work. It's the *difference between* the time of beginning and ending every single job.

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Here is an automatic machine that makes accurate, legible and unalterable records of elapsed time for any number of workmen—foolproof, unerring, economical, *a small single durable unit, not a complicated system.*

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**The Calculagraph Company**

**50 Church Street** **Dept. 12** **New York City**

# CALCULAGRAPH

*The Elapsed Time Recorder*

# Mercury

[ This is No. 2 of a series ]

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—that those men—who have made it their business to study trucking methods—diligently and with broadest vision—have whole heartedly endorsed the tractor (and its complement—the trailer) *as the greatest money saver* of the entire industrial vehicle group.

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*Note—To Interested Executives*

Our sole business is to make industrial tractors and trailers—and co-operate in successfully putting them to work for you.

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The Complete Line of Office Equipment

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# The One Horse Shay Served it's Purpose

*Hand Control*

BUT its day is gone, long, long ago. Modern life is too swift, too complex for such a transportation service to survive and serve efficiently.

Back in the days of slower production, of only fair quality in products, hand regulation of heat processes was good enough. But the demands of industry today cannot be met with makeshift methods and fair quality goods; only the best are wanted. And large scale production is absolutely necessary if competition is to be met.

*Tycos* Indicating, Controlling and Recording Instruments are first aids to absolute certainty in temperature control and indication. Plants the world over are producing goods based on *Tycos* readings safe in the knowledge that they are guarded by scientific control.

You too can eliminate rejections due to over or under heating, can insure the uniformity of your product, can cut down process cost and increase your production by installing *Tycos* control. For *Tycos* serves your industry as it does all others. Write for a catalog that applies to your product.

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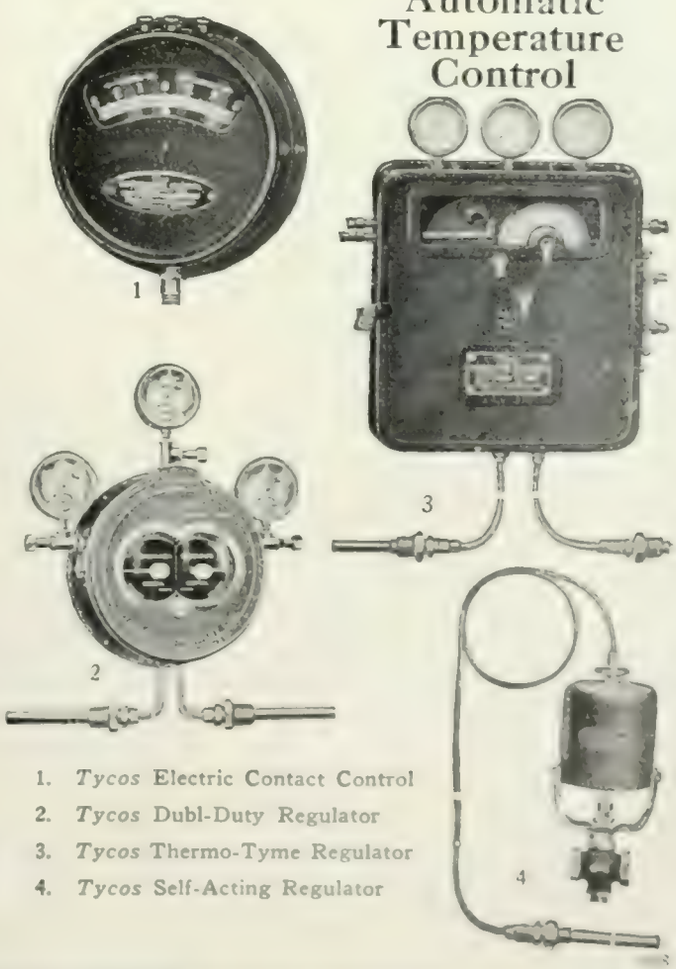


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Hyatt Line Shaft Roller Bearings have been lowering power transmission cost for more than 36 years. They are used with equal success in many parts of the world.

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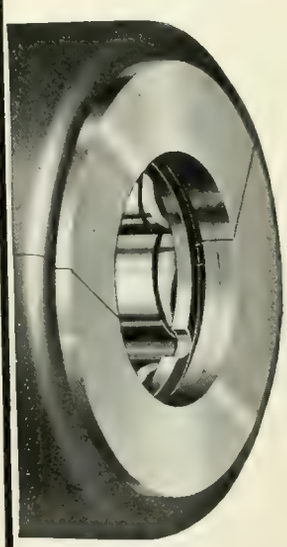

**Dealers, Note**

A few desirable territories still open for the New Hyatt Line Shaft Bearings. Write the Hyatt Roller Bearing Co., Newark, N. J.

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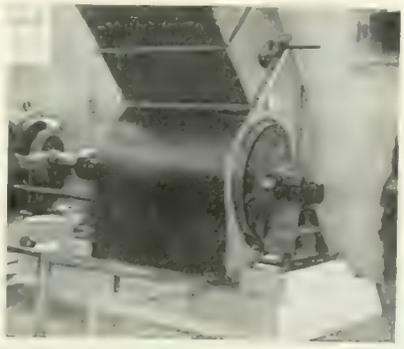

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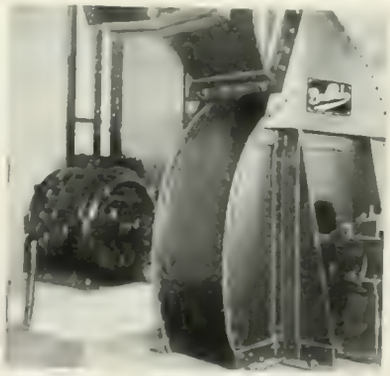

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The growing [illegible] or oil indicates the success of this fuel. Buffalo Type "R" blowers are built for just this kind of service. They have the highest efficiency practical, they are very strongly built, with large bearings, require little attention and occupy little floor space. We were the originators of this built-to-order high-pressure [illegible] other manufacturer.

We'll be glad to send you [illegible] with experience of users of

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Cincinnati, Ohio Holyoke, Massachusetts

# *Investments* must be Balanced

Suppose a professional man with $50,000 asked you to recommend a list of suitable investments. Would you suggest that he put the entire sum in public utility bonds, say—or in railroad stocks—or in foreign government bonds? Or would you recommend that he divide equally among the three?

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Similarly, prudent motor buyers emphasize *balance* as indispensable to the life and service of a motor. Every motor is a combination of the factors listed opposite. The life and service of the motor—its economy in first cost and in maintenance—result from the skill and foresight with which the manufacturer *BALANCES* these factors to one another in view of the particular work which the motor has to do.

**Westinghouse**

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# —so must a MOTOR

*—for instance, Temperature:* The degree to which a motor heats up under load depends upon the amounts of copper, steel, and insulation material which it contains, and upon the skill with which these are combined in the design.

By long study of heat flow in motors, Westinghouse has perfected methods of distributing materials and providing ventilation so as to give you a truly economical motor in size and first cost and still one that will not deteriorate because of excessive temperature rises.

## A Motor is BALANCED

when the following factors are properly proportioned to one another and to the job which the motor has to do.

| *Electrical* | *Mechanical* |
|---|---|
| 1. Temperature | 1. Air Gap |
| 2. Torques | 2. Bearings |
| 3. Efficiency | 3. Shaft |
| 4. Power Factor (in alternating-current motors) | 4. Steel |
| 5. Speeds | 5. Assembly |
| 6. Insulation | 6. Rotating Smoothness |
| 7. Commutation (in direct-current motors) | |

To get real motor value look at *all* these factors, not merely at one, or two.

In Westinghouse Motors each factor has been weighed after years of experience extending into every industry and dating from the dawn of the motorizing idea. A truly balanced design for every purpose is the result.

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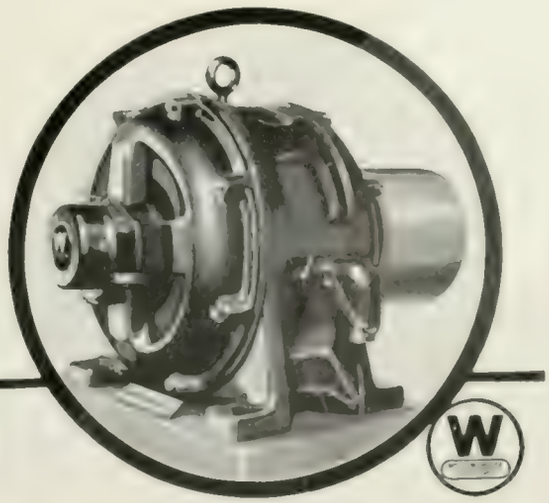

# Motors are Balanced

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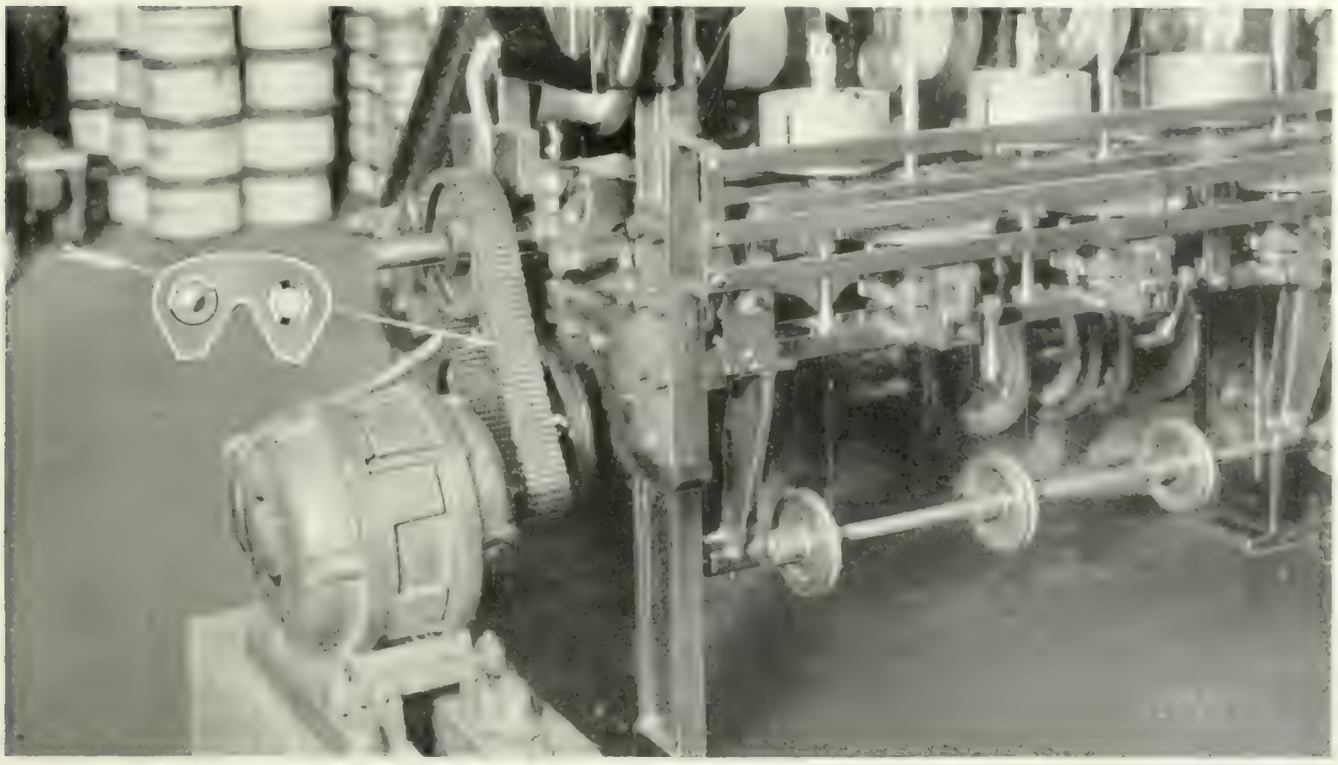

THEY say: "We now turn out 50% more wire per day on each machine, than we did a year ago. Part of this increase is due to higher running speeds, but at least 15% of this increase can be credited to the Link-Belt Silent Chains, because of the elimination of slippage and shut downs for belt repairs".

Today, after operating 55 hours a week for more than a year, these drives show almost no signs of wear, and have not cost a cent for repairs.

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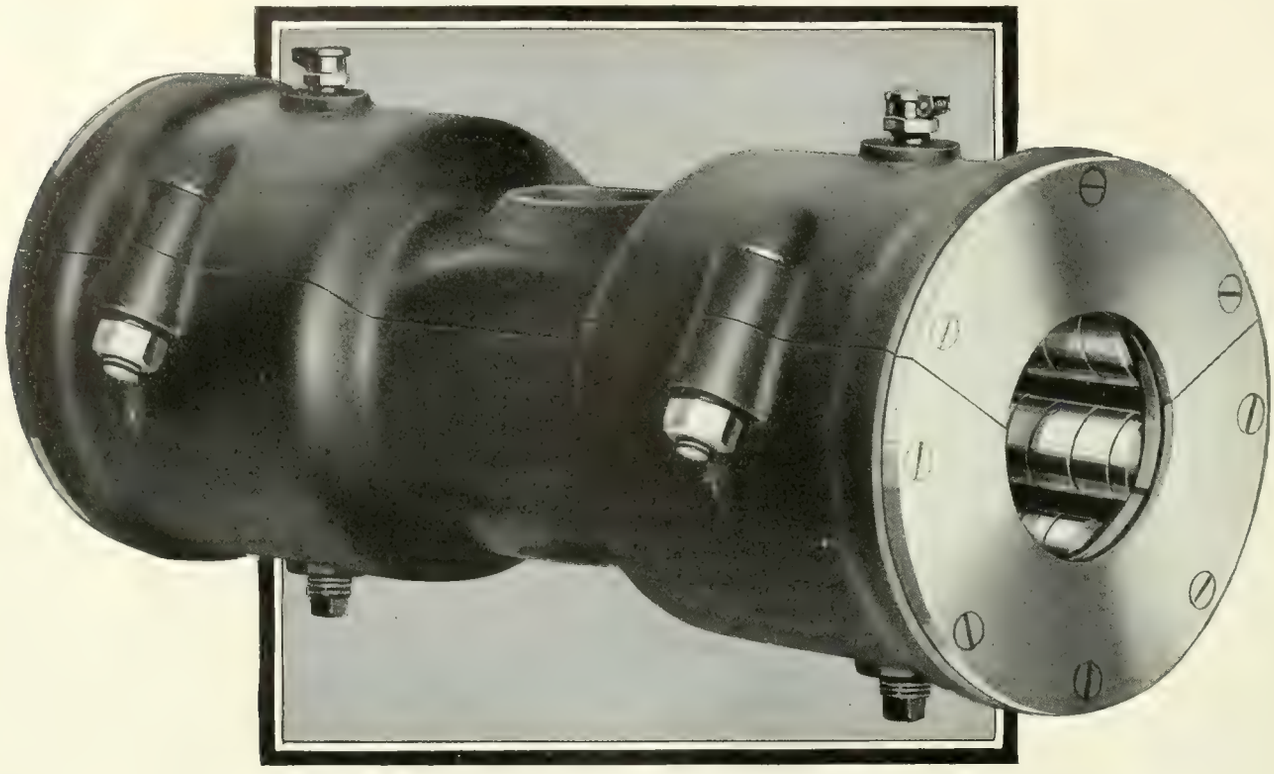

*Fits Narrow Hangers*
Available in the following sizes: $1\frac{7}{16}$", $1\frac{15}{16}$", $2\frac{3}{16}$", $2\frac{7}{16}$", $2\frac{15}{16}$"

# *No wonder it's meeting with such widespread demand*

THE new Hyatt Line Shaft Roller Bearing fits narrow hangers. Size for size, it is designed as an exact replacement box.

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No wonder it's meeting with such widespread demand. *Hyatt Roller Bearing Company, Newark, N. J.*

*Dealers Note:* A few desirable territories still open for the New Hyatt Line Shaft Bearings. Write the Hyatt Roller Bearing Company, Newark, N. J.

**HYATT**
**ROLLER BEARINGS**

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# MANUFACTURING INDUSTRIES

L. P. Alford, *Editor* — George E. Hagemann, *Associate Editor*

Vol. XI — CONTENTS FOR MARCH, 1926 — No. 3


| | | PAGE |
|---|---|---|
| Market Analysis Checks Over-Production | John N. Willys, *President, Willys-Overland Co.* | 165 |
| Applying Hourly Rates to Handling Equipment | F. E. Moore, *President, Mathews Conveyer Co.* | 169 |
| Search for Economy Alters Motor-Drive | R. H. Rogers, *Industrial Engineering Department, General Electric Company* | 171 |
| Reclamation Process Applied to Water | *A. P. W. Paper Company* | 174 |
| What Should the Net Profit Be? | W. L. Churchill, *Consulting Engineer* | 175 |
| Summarizing Costs for the Directors | Rudolph Rosenthal, *Treasurer, Jacques Kahn, Inc.* | 179 |
| Two Applications of Material Handling Methods | *Spicer, Flint Co. and Federal Motor Co.* | 184 |
| Simplified Production and Handling | H. H. Edge, *Works Manager, Kelly Press Division, American Type Founders Company* | 185 |
| Novel Budgets Cut Indirect Expenses | U. L Harmon, *Factory Comptroller, Mason Tire and Rubber Company* | 189 |
| Cost of a Short-Sighted Power Policy | Andrew F. Sheehan, *Mechanical Engineer* | 193 |
| Peerless Portland Cement Pioneers in Plant Design | John Gillespie, *Secretary and Treasurer, Peerless Portland Cement Company* | 195 |
| Analyzing Net Worth in the Industrial Investigation | Arthur Andersen, *Arthur Andersen & Co.* | 201 |
| Patent Pooling Develops Auto Industry | George F. Bauer, *Secretary, Foreign Trade Committee, National Automobile Chamber of Commerce* | 207 |
| Simple Storesroom and Storage Yard Methods | *Southern Pacific Railroad Shops* | 210 |
| Safety Progress Requires Better Records | | 211 |
| Guide to Latest Information | | 213 |
| News of Manufacturing Industries | | 218 |


Rutledge Bermingham, *Advertising Manager* — L. G. Henderson, *Circulation Manager*

Published monthly by THE RONALD PRESS COMPANY, [illegible] Publication Office, Lancaster, Pa. Editorial and Executive Offices, 15 Park Row, New York. Change of Address [illegible] each.

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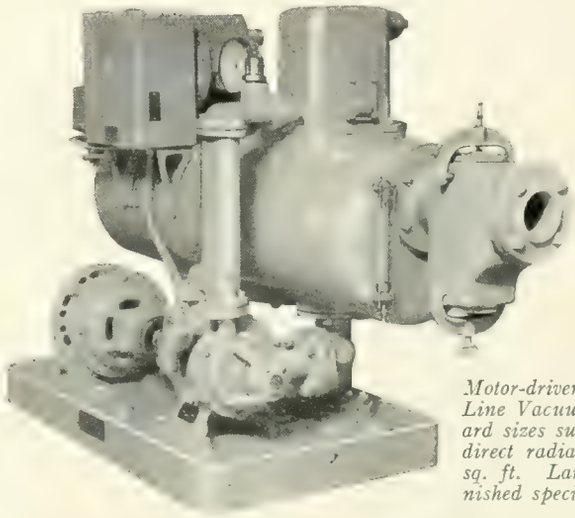

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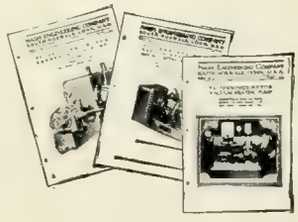

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# *Jennings Pumps*

RETURN LINE AND AIR LINE VACUUM PUMPS—CONDENSATION AND CIRCULATING PUMPS

# MANUFACTURING INDUSTRIES

VOLUME XI MARCH, 1926 NUMBER 3

# Market Analysis Checks Over-Production

## Co-ordinating Output with Sales Acts as a Stabilizer for Industry

By JOHN N. WILLYS

*President, Willys-Overland, Inc.*

OVER-PRODUCTION—the nemesis of the automobile industry from mechanic to salesman, from dealer to manufacturer—involves a problem of important bearing on not only the actual manufacturing, but also on the various means of distribution. The most effective solution will be found in the direction of an output adjusted to actual demand as determined from current and probable sales to be made by the dealers in various parts of the United States and abroad.

A similar problem confronts every manufacturing industry. Because the makers of automobiles have attacked their particular end of the difficulties energetically and have profited materially by the improved methods brought about, a presentation of the development and application of these new methods may be of definite assistance to executives engaged in other branches of manufacturing.

Ever since the automobile industry outgrew the infant stage and started on its way toward becoming one of the leading, and surely a guiding business in this country, the matter of production has been the chief concern of manufacturers. Until only comparatively recent times, every manufacturer felt that his success depended upon a huge scale of production, for dealers were plentiful and it remained for the builder of automobiles to supply cars just as fast as possible.

Evidence of the situation prevailing then is revealed in the fact that the manufacturers secured considerable working capital by asking and obtaining from the dealers in advance certain deposits to be applied against the payment of the cars when finally shipped, or against the purchase of repair parts on open account. The cash deposits thus obtained from the dealers often amounted to as much as the entire capital of some manufacturers and assisted to a marked degree in the launching of the industry. This arrangement, although of the past, tends to emphasize the great importance attached to the productive phases of the industry.

With the industry still young, with the public on the whole showing a strong desire for automobiles, there were many openings for new concerns, each with some particular design, some unique feature characteristic of its special product. Because of the newness of the automobile, these features patent to each car were, perhaps, the reason for continued existence of some manufacturers, and formed their chief stock in trade, for the automobile makers had not yet come to concentrate on standardized practices.

Next came the period of prosperity immediately preceding the war when automobile manufacturers

saw their product become a family necessity, with a subsequent wave of buying due to the influx of money from other countries for war munitions, high wages and other causes.

Then followed the war-time period when the bulk of automobile manufacturers turned their attention to building implements and accessories of war. Automobiles, as far as every-day, constant production was concerned, were relegated to the background temporarily while the manufacturers turned out guns, munitions, airplane engines and other military products for which their plants were most suitable.

The reaction in the automobile industry following the close of the World War was first noticed among the manufacturers. A complete revamping of their plants and productive organizations was necessary in many cases, because of conditions which had grown up under the demands of the war regime. It was, in short, a race to get back into production before the other fellow. Those were trying times. Obtaining steel, rubber, and other raw materials was a serious matter, and in some cases, manufacturers were ready with their own productive organizations before they could actually secure the necessary raw products.

The years of 1920 and 1921 might be termed "pick-up" years, for it was during these 24 months and even into 1922 that manufacturers were gathering together an efficient productive organization to build the cars that would be wanted in the more prosperous after-war period. As far as sales were concerned, 1922 was a fair year, but it was not until the spring of 1923 that manufacturers entered the production stride that, in the following year brought the disadvantages of over-production forcibly upon them. The ascending production scale held through 1922 and throughout 1923 until June of the following year, when the peak of production was reached. It was in the spring of 1924 when all dealers began finding themselves stocked high with cars.

Then came a decided reaction. Stocks slumped and future orders tumbled. The manufacturers had overshot their mark with a production total unjustifiable by either present or future demands, and the brakes were put on. Production was dropped within a few months to a point equal to that of three years previous, and subsequently even lower.

The year of 1924 taught many lessons to the automobile manufacturer. It brought home the fact that dealer organizations must be perfected and that production must be correlated to dealer demands. The deflation and slump of the latter part of 1924 was practically equivalent to the post-war effect on manufacturers, but the lessons were well-learned and brought about a strengthening of the entire dealer organization.

For the first time a truly comprehensive plan was started by leading manufacturers to minimize over-production and to build automobiles as near to the dealers' demands as possible. The spring of 1925 bore out the fairness and applicability of this plan. As a result, 1925 again established a high mark, not only in production, but in actual sales, for dealers were assured of a production that would not overwhelm them just as they struck the buying months. In other words, dealers were confident of their own and their factory's positions.

In connection with a plan of this kind it will be found that two factors must be considered in apportioning the expected production for the ensuing year. First of all, it must be divided into monthly quotas, so that production will keep pace, as closely as possible, with sales of various seasons of the year. Second, it must be further allocated by monthly quotas over the various wholesale territories, which in turn are broken down into retail dealers' allotments.

Percentage of national production emanating from the Willys-Overland plants will vary from month to month. In some months our portion will exceed a definite figure established from previous performance and used as a guide, while in others it will fall below that figure. Previous experience comes to our aid in apportioning production on a monthly basis.

In the distribution of automotive products two main phases, wholesale and retail, are considered. For the purpose of informing readers who are not familiar with this plan of organization, a slight digression will be necessary here to briefly explain certain fundamentals.

Branch offices, in some cases, and independent distributors, in others, constitute the wholesale organization. A group of counties, a whole state, or several states, depending on density of population and other factors influencing sales volume, are allotted to each

FIG. 2 TOLEDO FACTORY OF WILLYS-OVERLAND, INC., 86 BUILDINGS ON 199 ACRES OF LAND

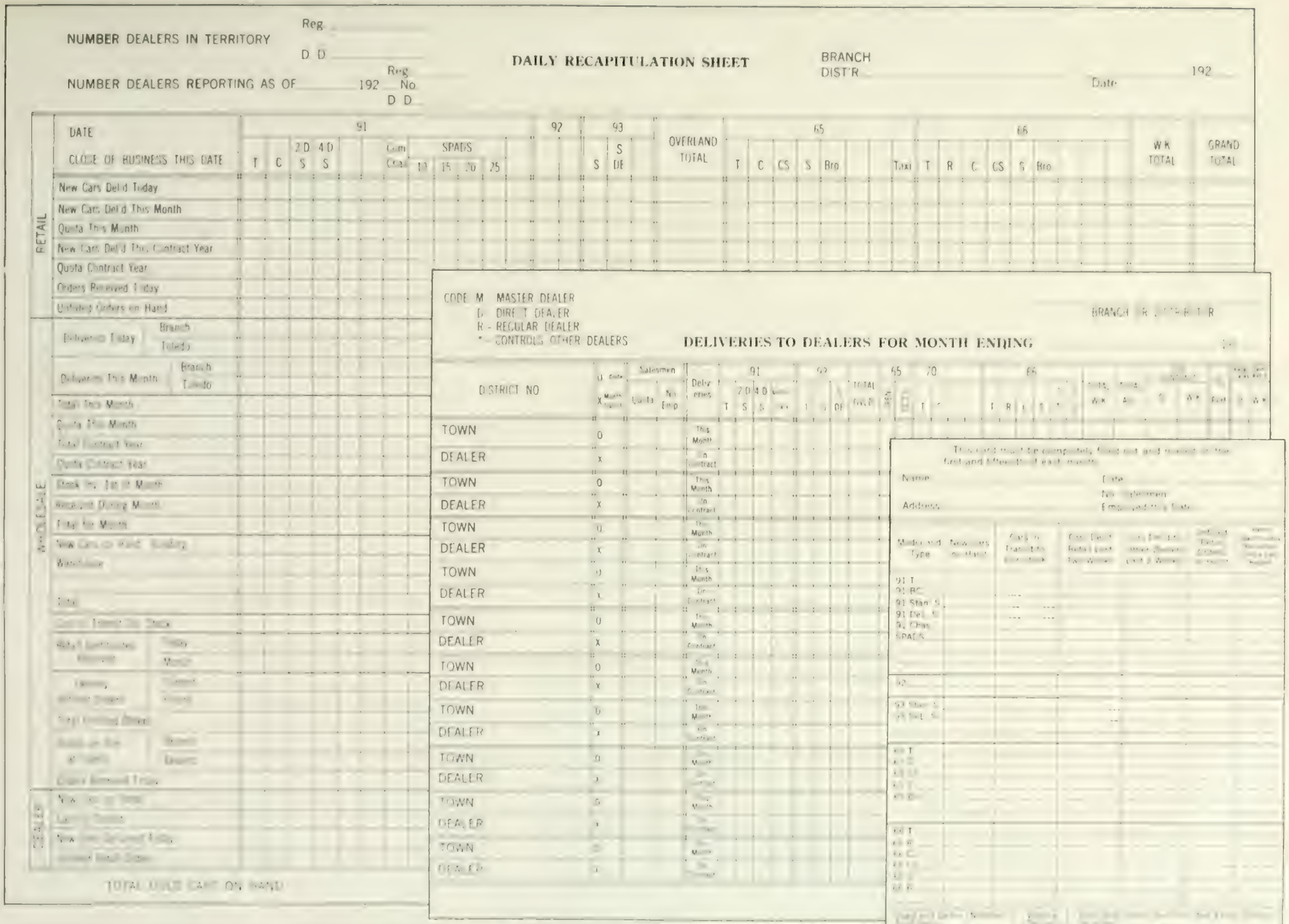


Fig. 1. Daily Recapitulation Sheet (11 by 17 ins.), Monthly Record (8½ by 11 ins.) and Bi-Monthly Report (5 by 7 ins.) Used Dealers and Distributors

of these wholesalers. Within this clearly defined territory the wholesaler's retail organization is built up.

Wholesalers as a rule maintain a retail organization for merchandising cars in a limited territory contiguous to their establishment, which is separate and distinct from their wholesale functions. It will be readily realized that this retail organization could not effectively cover the entire wholesale territory, however, and it is for this reason that retail dealers are appointed in other towns and cities. These dealers in turn have associate or sub-dealers in cases where their territories are exceptionally large. In some localities wholesale dealers have over a hundred of these dealers and sub-dealers.

The factory sales department, after making an estimate of production for the ensuing year, informs branches and distributors just what their monthly quotas will be for that period. Past performances have also shown a definite numerical relationship between production of the various models. In setting quotas for the branches or distributors use is made of these percentages in apportioning allotments among the different types of cars.

Dealers are required to sign new contracts every year. Monthly quotas are an integral part of these contracts and it is the aim of the branches and distributors to see that these quotas are adhered to in so far as circumstances will permit.

Having already been notified by the factory sales organization as to their quotas for the term, branches or distributors apportion them among the dealers in accordance with their demonstrated capabilities and the possibilities of their respective territories. By analyzing new car registrations in a given county, by makes, during corresponding periods of the past, comparing figures of a given car with total registrations of all makes, it is possible to arrive at a fair monthly quota for the dealer. In fixing this quota, percentages accounted for in the total production by each of the models are taken into consideration and each quota is broken up into similar percentages of each model.

Bi-monthly reports are required of the dealer by the branch or distributor. Cards on which these reports are made are sent by distributors to dealers twice each month with the request that they be filled out and returned on the first and fifteenth days of the month. (See lower right hand form in Fig. 3.)

These bi-monthly reports indicate, for each model, the number of cars on hand on the reporting date, the number of unfilled orders on the dealer's books, the number of cars in transit to him, the number of cars delivered to him in the past two weeks (separate columns being provided for deliveries to himself and deliveries to his sub-dealers should he have any), and the number of deliveries which he has made to customers since his last report.

In connection with the last item referred to, an interesting method is used to obtain specific information concerning sales of the products. Cards are made out bearing the motor number, model, and other data concerning the car and are attached to the steering-post of each car as it leaves the factory. Dealers are expected to have their customers sign these cards and indicate thereon their addresses when the car is delivered, and to return the cards to the main sales office.

Daily Recapitulation Sheets (see largest form in Fig. 3), are sent to the factory by each branch or distributor, giving number of cars of each model on hand, shipments made that day, and other data indicating the speed at which the various models are moving. On the fifth and twentieth of each month a summarization of reports received from dealers is included in this report in a space provided for it. (See bottom section of largest form in Fig. 3.)

In addition, monthly reports are made by each branch or distributor giving the number of cars of each model delivered to every individual dealer during the preceding month and the number of cars which he contracted for in each case. (See middle form in Fig. 3.) These reports are merely a recapitulation of the distributor's shipping records, which give a composite picture from all dealers of the district.

All of these reports are not only vital to the factory in making up correct production schedules but they also enable the distributor to locate any weak spots which may develop in his dealer organization. Should any dealer fall below his quota, a representative of the distributor will call upon him, analyze the situation, and give the dealer expert assistance.

With these reports, moreover, distributors are better able to place orders at the factory in such a manner as to enable the latter to make the best possible arrangements for prompt shipments.

The co-adjustment of production with sales demands has been the chief feature contributing to the stabilizing of the industry. With approximately 4,000,000 cars as a sales constant, manufacturers know in advance practically what their production demands will be from the standpoint of sales. Of course, all this readjustment has meant an increase of personnel and work, in certain departments, for no large manufacturer is now without his sales statistical department, nor his sales estimate division, the duties of which are to adequately sound and examine the past buying markets, and to make correct analyses of future markets.

I thoroughly believe, with this sane policy of co-ordinating production with sales demands, barring outside disturbances, that the industry will go ahead on a stabilized basis. In our own organization we are sincerely looking to the welfare of our dealers, believing that their prosperity is essential, not only to our own prosperity, but to that of the country at large.

Speaking for the automobile industry, I believe this policy has led to a strengthening of the once weak faith of the public in the manufacturers. If the automobile producers of the United States will, in the first six months of 1926, try for a balance of production and sales demand, this year will break all records and permanently establish the industry as a leading factor in our industrial and civic development.

# New Cost Basis for Material Handling

## Modified Form of Machine Hour Rate System Applied to Conveyors

By F. E. MOORE

*President, Mathews Conveyer Company*

WITH the growing use of material handling equipment in manufacturing plants has arisen a demand for a closer knowledge of how to correctly apportion its charges to work. Hand labor has always offered a very perplexing problem from the standpoint of accurate costs, aside from wages, because the overhead involved took in so many factors, many of them of somewhat intangible nature. The substitution of mechanical equipment not only saves money in a direct way by its superior efficiency over hand labor, but it also eliminates or reduces the indirect, or burden, costs of handling operations, and makes more readily measurable those which cannot be avoided.

The use of the machine hour rate for calculating operating costs on productive equipment has long been practiced, and offers one of the readiest and most nearly accurate means of measuring the expenses of running such equipment. Obviously, a system which had worked well under the severe tests of long practice in its application to productive equipment presented evidences of being adaptable to the related shop operations of handling material. The experimental period had been passed through in the one field, and out of the experiences encountered, a definite practice had been developed. While some trial efforts would have to be made in the new field, yet the working out of methods would take much less time and the success or failure of the new application would soon become evident.

Hence, in 1924 a modified form of the machine hour rate plan was developed and applied to the handling equipment in the Mathews Conveyer Company plant

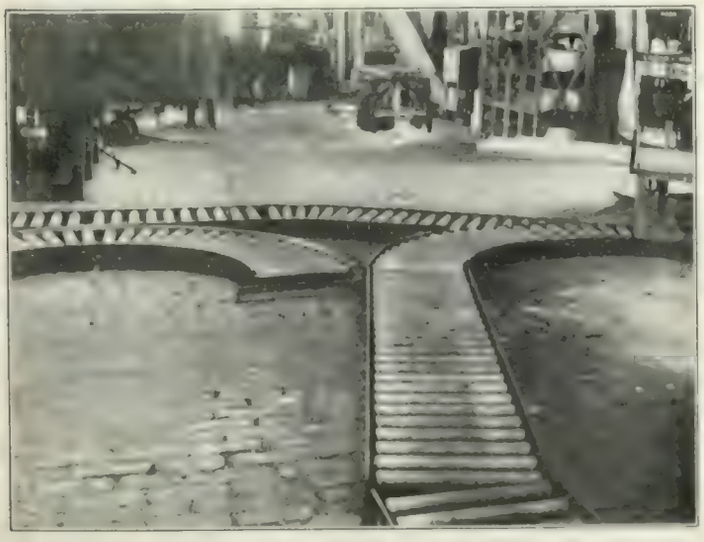

FIG. 1 SECTION OF FLOOR SYSTEM IN PUNCHING ROOM
In the foreground is a two-way roller conveyor switch

FIG. 2 ELEVATOR TO OVERHEAD LINE IN ASSEMBLY ROOM
Boxes of parts from the machine room are delivered on the gravity conveyor at the right and by means of the elevator are fed to the overhead system in the assembly room.

The method has proved successful during the course of its two years' test.

The equipment, for convenience and accuracy in figuring, is divided into four lots:

1. Conveyors on the floor in the rail punching department.
2. Conveyors used to deliver parts to the assembly department and to return empty carrying cases to the finished stock room.
3. Conveyor serving the welding tables and paint trolley.
4. Overhead trolley system from assembling department to shipping department.

The purchase price of each piece of equipment formed the starting point from which to make calculations. To this was added the cost of installation. Then an estimate, calculated as carefully as possible, was made of the probable life of each item.

Based on experience, the indications were that the

last three systems listed above would give good service for a period of 15 years to come. The first system gets the roughest use and accordingly its useful life was set at 10 years. The accounts were therefore adjusted to amortize the investment in these various pieces of apparatus in the periods mentioned.

Unless the factor of obsolescence enters in, which is hardly likely, it appears that when the useful life of the various systems, as estimated above, has terminated, an outlay of $1000 for extensive overhauling and adjustment will put them in shape for still further efficient service. The amortization figures for use

FIG. 3 FROGS TO SHUNT BOXES TO ASSEMBLY LINE

The spiral roller conveyor in the rear receives the boxes from the overhead line and delivers them to the floor level. The elevator at the left takes empty boxes back to the machine room.

in determining the hourly cost rates for equipment, however, have been based on the 10 and 15 year periods, as above explained.

Included for convenience in the price of equipment are two other figures of equipment expense, namely, upkeep and repairs and the small amount of power consumed by each, both over the period of assumed life. No charge is made for floor space, as much of the equipment is overhead and only a small portion occupies floor area formerly traversed by trucks.

Rent, taxes, heat, light, supervision, and certain other items are not charged directly against the conveyor systems. In this respect the method differs from the regular use of machine hour rates, because for productive equipment such items of plant overhead are directly apportioned to the various pieces of apparatus. In the Mathews Conveyer plant, the items listed above have been calculated into a general hourly operating rate set up for the whole factory and applied as burden to the various departments. The conveyor systems themselves are treated as a local burden in the departments in which they operate.

The conveyors are all automatic. Some are of the gravity type and some are power-driven. Hence no

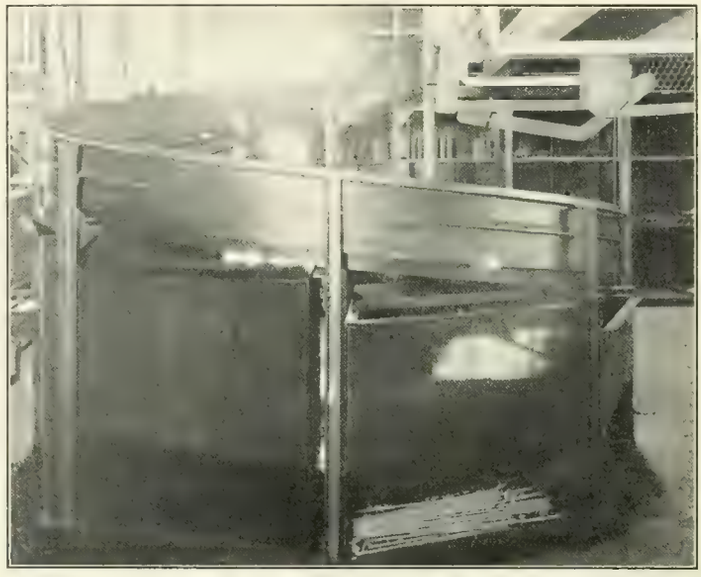

FIG. 4 SPIRAL ROLLER CONVEYOR

This spiral delivers empty boxes returned from the assembly room to the line of roller conveyor into the machine room.

addition for "men required to operate" is necessary.

Table 1 shows the values and calculations used to determine the hourly rate on each system of handling equipment. The development of price and amortization period figures has already been explained. The number of hours values used in the table are found by deducting from 365 days the 52 Sundays, 26 days for Saturday half holidays, and 4 holidays, and multiplying the remainder by 9 hr. per day, giving 2547 hr. per year. In 10 years this amounts to 25,470 hr. and in 15 years to 38,205 hr.

TABLE 1. CALCULATION OF HOURLY RATES

| System No. | Price | Amortization Period, Years | Number of Hours | Hourly Rate | Cost per 9 Hr. Day |
|---|---|---|---|---|---|
| 1 | $1980 | 10 | 25,470 | $0.078 | $0.70 |
| 2 | 5908 | 15 | 32,205 | 0.155 | 1.40 |
| 3 | 921 | 15 | 38,205 | 0.024 | 0.22 |
| 4 | 995 | 15 | 38,205 | 0.025 | 0.23 |
| | | | | | 2.55 |

The economies effected by the use of this system of conveyors on an average per day are as follows:

| | |
|---|---|
| System No. 1 | 9 hr |
| " " 2 | 18 " |
| " " 3 | 2 " |
| " " 4 | 9 " |
| Total | 38 " |

This saving, figured on a minimum labor rate of say $0.50 per hr., amounts therefore to $19 per day.

# Search for Economy Alters Motor Drive

## Fractional Motorizing Often Cheaper than Group or Individual Method

By R. H. ROGERS

[illegible]

DRIVING machinery by electric motors has gone through a process of evolution by which the power has been carried in the wire closer and closer to the work. The working processes themselves, in the last step, have been split up into components, with the power carried in the wire to each operating part of the machine. This development is a logical trend, because power in the wire:

1. Suffers no appreciable loss
2. Does not have to be lubricated
3. Spoils no goods in process
4. Is wearing out nothing
5. Makes no noise
6. Does not obstruct light

Here is the power, over there is the work to be done; the gap can be bridged with mechanical devices, or the power can be wired up so close to the machine processes that no mechanical devices intervene. The net results of this move have been: First, a reduction in power losses, of minor importance; second, a very marked reduction in maintenance and lost time costs; and, third, the use of the best type of motor and control for each subdivision of the work, a matter of considerable practical value.

The early practices of replacing a water wheel or steam engine drive with an electric motor, or splitting up a giant mechanical drive system into motor-driven departments (Fig. 1) were justified at the time as being the only well understood and appreciated methods of applying electric power. Some power was saved, especially when only certain departments were run while others were shut down. Maintenance of interdepartmental shafting and belts was done away with and some degree of improvement was obtained in steadier speed and more nearly continuous running. The power was taken from the wire too far from the work, however, for line shafts and belts, countershafts and belts, and gears and belts still intervened in and about the machines themselves. In some cases, machines were several hundred feet from the motor.

FIG. 1. A GROUP DRIVE OF DEPARTMENTAL GROUP DRIVE IN A FACTORY

A 10-hp. motor driving one breaking machine, one bending jack, six sinking jacks and three rolling jacks. If individually driven, the motor name plate ratings would aggregate much more than 10 hp., but the kw.-hr. consumed would be less.

"Four frame drives" are built in several forms and the closely related machines justify this form of group drive.

Group driving was early recognized as an improvement, because a few related machines could be run

or stopped to suit production, without driving a great fabric of shafting and belts. Maintenance and lost time were further reduced because the power was kept in the wire until closer to the work. There were still the countershafts with leaky bearings overhead, the

FIG. 3 A COMPACT FORM OF INDIVIDUAL MOTOR DRIVE WITH CONTROL CLOSE TO THE MOTOR

Such installations run to many thousands in the textile industry. The room is clean and light and there is no power wasted.

man with the ladder wandering around among high-speed machines, high-priced operators, and stacks of materials in various stages of production. Loose pulleys ran hot, belts stretched, were taken up by a service man, or broke occasionally with a vicious slap at the nearest operator. Machines were lined up with reference to line shaft and belt centers and material flow came off second best. There are still many applications of group drive, however, such as shown in Fig. 2, which are justified and will be retained.

Individual drive is now recognized in many manufacturing processes as the most desirable method of applying electric power to the work. Here the wire carries power right up to the machine itself. The machine, if a large one, can be started or stopped from several convenient stations rather than from a single shipper rod or controller, as is usually the case with group drives. Each machine can have for its driver the best type of motor for its peculiar requirements—constant speed, adjustable speed, varying speed (according to load), high torque, high or low speed, and so on. The type of control becomes amenable to the job in hand, thus resulting in smooth starting and absence of line disturbances that often arise with larger group drives. Individual motor drive is very popular in textile work, as is shown in Fig. 3. The motors are belted, geared, chained, or direct-connected to some main part of the machine and all other moving parts take their power by belt, or gear, or chain, from that driven part. But in some cases there are very slow speed parts and very high speed parts in the same machine, necessitating nests of speed changing devices, subject to wear and misadjustment.

Power is, in some cases, used in several places in the same machine, many feet apart and for purposes differing widely in character, though the machine itself is individually motor-driven. Where normal motor and machine speeds can be made the same, or can be brought together by a moderate amount of gearing, direct connection is resorted to, as in the case of centrifugal pumps. Certain machines, such as rock crushers, vibrate so severely that a belt connection is required to protect the motor. Much lost motion,

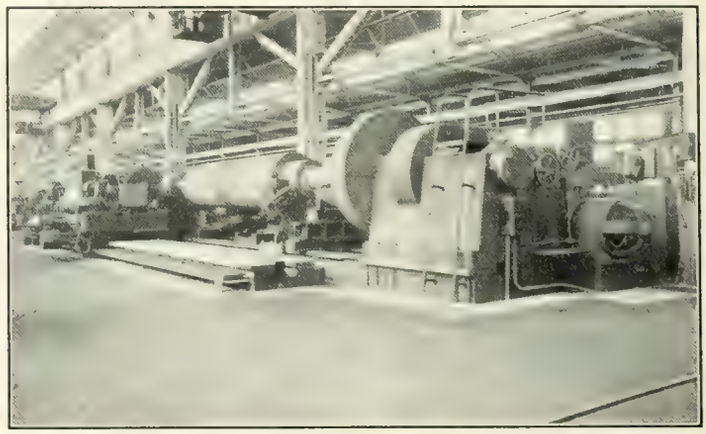

FIG. 4 EACH OF THE EIGHT COMPONENT POWER PROBLEMS IN THIS GIANT LATHE IS SOLVED BY ITS OWN MOTOR AND CONTROL

All are interlocked to maintain proper sequence of operations and to prevent overloads. A great quantity of gearing and transmission devices was eliminated by this method of drive, and each motion is powered and controlled by the best method.

noise, wear and lost time are caused by the intermediate mechanisms co-ordinating the machine parts.

This leads up to what is the last step—the motorizing of each power-using part of a single machine. This practice is being rapidly adopted for machines of complex nature, with results as gratifying as were those that followed the change from group to individual drive. This new phase might be called "fractional drive," to distinguish it from the "one machine-one motor," or individual drive.

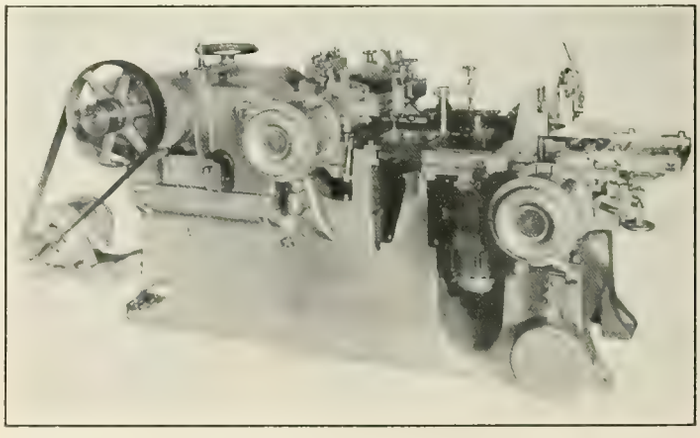

FIG. 5 APPLICATION OF FRACTIONAL DRIVE TO A MOULDER

This moulder, a woodworking machine, has four high-speed-spindle motors and a general-purpose feed motor. To drive such a machine with one motor would require bevel gearing, belts, clutches and other mechanical transmission devices.

Motors for driving the individual elements of a machine are sometimes "built-in," or at least part of them may be built-in, with others mounted on the machine, or on the floor, to suit the work.

A recently installed grinder-lathe for turning and grinding the rotors of huge electric generators is driven by eight d. c. motors, each adapted for its own work, each with a suitable control, all interlocked so that

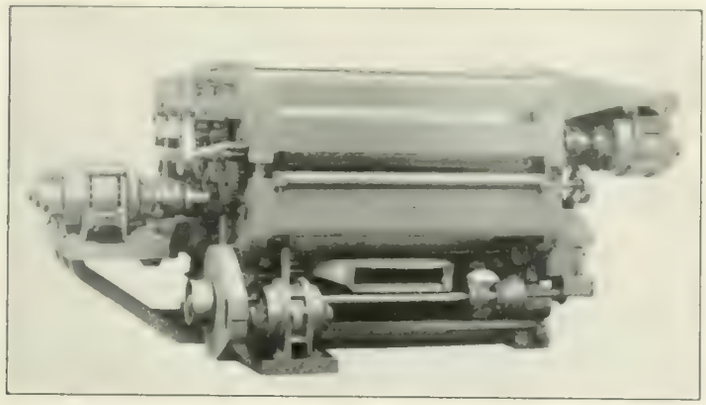

FIG. 6 THIS SIX-DRUM SANDER TAKES SEVEN MOTORS

Complete doors are passed once through this machine for sanding in three grades on both sides.

they cannot be started out of sequence, and each or all stopped from several safety stations. This giant Niles-Bement-Pond lathe (Fig. 4) will take work 45 ft. between centers, 113 in. swing over the bed, and will handle a piece weighing 150 tons. The main drive motor is rated 75 hp., has a speed adjustment of 3 to 1, is reversible, and is shunt-wound. Push-button stations controlling speed and direction of rotation are located on the carriages, on the grinder and on the headstock. "Safe" buttons prevent starting except

FIG. 7 A FULLY MOTORIZED NEWSPRINT MACHINE

This machine is used for making sheets 13½ ft. wide at the rate of 1200 ft. per min. Nine main drive motors take the place of the old back line with its complicated array of belts, cone pulleys, right-angle turns, and many bearings. Doubling the speed and production is a feature of the sectional system of driving paper machines.

from the station from which it was stopped. Each carriage takes a 10-hp. shunt-wound motor, push-button-controlled and so interlocked that an overload on the main motor slows down the tool feed and a feed cannot be started unless the work is turning. High-speed traverse for the carriage is provided. The grinding wheel is driven by a 25-hp. high-speed motor with 2 to 1 speed adjustment. A small motor drives the grinding wheel pump, a 7½-hp. compound-wound motor the tail stock.

Wood-working machines lend themselves readily to built-in motor drives with motors mounted on each spindle, drum or cutter, as in Fig. 5. Feed motors are usually slow-speed, general-purpose motors, outside-mounted. The working shafts with the motor rotor only a few inches from the cutting tool may operate at speeds as high as 26,000 r.p.m. Such high-speed motors are driven from a frequency-changing motor-generator. The high speeds allow faster feeds without leaving tool-ripple marks on the work, thus increasing production. This is taking the power in the wire to the last possible inch of distance up to the

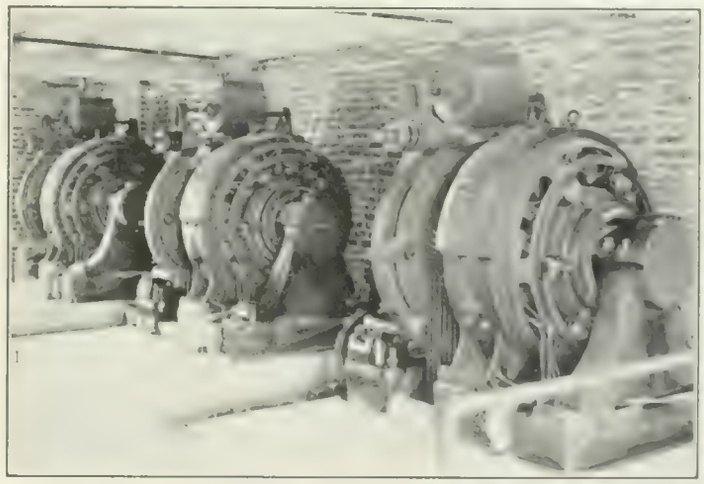

FIG. 8 GEARLESS TRACTION ELEVATOR MOTORS

The highest-speed elevators are driven by the slowest-speed motors. These motors run at 65 r.p.m. The cables that run directly to the elevator car run over a drum next motor armature. The solenoid brake mechanism is a prominent feature, as its importance warrants. The power is delivered by wire close to the load.

work. The whole complex machine, with its many high-speed members, becomes simply pairs of bearings carrying short shafts with tool and motor close together. Drum sanders, molders, end tenoners, mortisers, and the like, take from two to six or eight motors, each with its own control. A seven-motor machine is shown in Fig. 6.

Sectional paper-machine drive offers a great contrast in size to the former type of equipment, as a whole and in the size of the motors used. Formerly the eight or more sections of a paper machine were driven from a line shaft along the back, or in the basement, and thus running at right angles with the section-drive shafts. Right-angle turns, clutches, and cone pulleys for adjusting speeds were required, with

numerous supporting bearing to be maintained.

Disregarding power loss, which was considerable, the "back line" maintenance cost ran about $0.35 per ton of paper produced and, worst of all, the speed was limited to 500 or 600 ft. of paper per min.

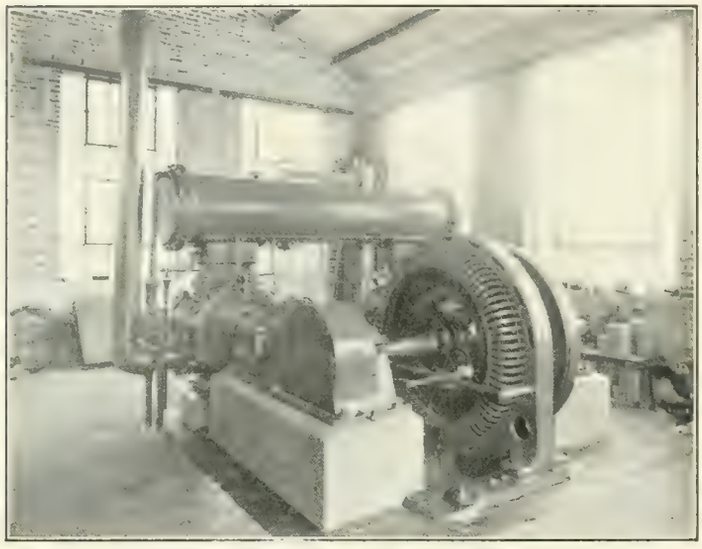

FIG. 9 MOTOR-DRIVEN AIR COMPRESSOR

A slow-speed synchronous motor is mounted directly on the shaft between the two cranks of the air compressor. This makes a compact unit of high efficiency. The installation shown is in a railroad shop.

Sectional drive puts a motor on each section, as in Fig. 7, cuts maintenance cost to $0.12 per ton, and enables the production to be speeded up to 1000 or 1200 ft. per min. Specifications now call for paper machines to run 1400 ft. per min. Thus, taking the power in the wire right up to the working shafts speeds up production and cuts maintenance costs.

Even for very slow-speed work it has been found advantageous to eliminate gearing, putting the motor very close to the work. An example is the gearless traction elevator now almost universally used for high-speed, high-lift passenger elevators. The motor runs at 65 r.p.m and the rope sheave is mounted directly on the hollow forged motor shaft between the armature and the bearing, as indicated in Fig. 8. Thus the motor elements are right up against the sheave that handles the car and counterweight.

Reciprocating compressors and vacuum pumps are normally slow-speed machines and, in order to eliminate all intermediate devices, slow-speed synchronous motors have been designed for driving them. Some run as slow as 80 r.p.m. The rotor is mounted directly on the compressor shaft between the cranks, as in Fig. 9, thus delivering the power close to the work.

Farm machinery, only just now being motorized, is already being subjected to analysis as to segregation. During the past season a threshing machine was built with individual built-in motors for each motion—cylinder, shaking screens, wind stacker, etc. Heretofore a threshing machine has always been a fascinating assembly of belts, pitmans, gears, cranks, and what-not, all driven from one pulley through a long belt. Obviously, the character of the loads varies greatly. The motor-driven threshing machine mentioned was consequently equipped with a fan motor on the wind-stacker fan, a different type of motor on the cylinder, and still different ones on the various other motions, as required. The result is a simplified, more efficient and thoroughly reliable machine, because the power is kept in the wire to the last possible inch of distance up to the work.

# Reclamation Process Applied to Water

WHEN speaking of the reclamation of industrial wastes one scarcely thinks of extending this work to water. In most plants care is exercised to prevent the waste of water, and wherever possible it is used over again. But paper companies found it profitable to remove fine particles from used process water, and put both the particles and water back into service again.

A private well gives a practically inexhaustible supply of water to the A. P. W. Paper Company, yet this water is not wasted nor allowed to escape from the plant without yielding its maximum value. Though the water is now obtained practically free, handling it and raising its temperature involve costs which can be held down. The company's mills require 5,000,000 gal. every 24 hr., but of this amount 4,000,000 gal. are reclaimed and used over and over again.

Water is the principal conveyor of the company's material in process. Used water becomes white by being contaminated with tiny particles of pulp. This white water can be used in some of the later manufacturing processes. Other processes require pure water, for the fine white silt or powdered fibers would settle in some of the machines and clog them, shutting them down or rendering them inefficient, and in either case costly to run. Removing the silt from the water would enable it to be used in a greater number of successive processes. So reclaiming machines called "save-alls" were installed in the basement to withdraw this fine pulp powder from the water.

Thus the water can be turned back into the supply at an early point in the manufacturing processes. That reduces by a corresponding margin the total fresh water that would have to be taken in each day to make up for evaporation and waste.

At first the type of save-alls developed was not very efficient. But experimentation found reclaimers so effective that even the fine particles of pulp removed from the water by the save-alls can also be turned back into the pulp stock and so used again. Both the pulp powder and the water are made useful by their complete separation.

# What Should the Net Profit Be?

## The Basis for Estimating and Including Profit in Fixing Selling Prices

By W. L. CHURCHILL

*Consulting Engineer*

THE profit ideals and ideas of manufacturers are as varied as the men themselves. It is the variations in these concepts and points of view that are largely responsible for differences in offered selling prices of similar commodities. As all manufacturers of competitive products have to meet the lowest offering prices, the differences in profiting practices ultimately force low price levels.

What should your average net profit be year after year and not as an occasional stunt performance?

This is a stock question that I have put to many manufacturers in the course of surveys to determine causes for low profit levels in manufacturing. The variety of answers indicates the lack of common understanding on what profits should be earned.

### Six Points of View

In six successively visited plants, all engaged in manufacturing of the same paper products, I received the following six different answers:

*Answer 1.*—I aim to make 33⅓ per cent of what my paper costs. I consider my business really as selling paper and I add paper, labor and overhead, then 33⅓ per cent of what I pay for the paper to get my selling price. You see I started as a jobber of paper and found that by converting the paper into a few products I could get a larger profit on that paper.

*Answer 2.*—I aim to get 10 per cent of selling prices after all costs have been paid. You see in this business one cannot set selling prices but has to sell according to competitors' prices. On some goods I lose money, on others I make, and if I average to net 10 per cent on sales I feel that I'm doing quite well.

*Answer 3.*—I aim to make 10 per cent on my investment. I don't own the buildings but pay rent (very low) and I buy power. I sell to only a few large buyers so that I usually collect from my customers before I have to pay for my paper. In this way I really do business with my customers' money, and my own investment is small so I can produce very cheaply.

*Answer 4.*—I aim to get 10 per cent on my investment. Own land and buildings, also power plant, as well as all machinery and equipment. My business is with a large number of small accounts for whom I stock products in anticipation of sales. My receivables average about 45 days.

*Answer 5.*—I make about 20 per cent on my capitalization. This is very small but I've not seen fit to increase it although my actual investment is several times the capitalization.

*Answer 6.*—I ought to make about $100,000 per year, but am lucky to make anything at all. In years past I have made more than this but competition has shot the business all to pieces. I don't pretend to run a cost system, had one but threw it out because I couldn't get the prices that my costs indicated I should. I simply get the best prices I can.

Not one of these six typical manufacturers considered profit as something within his control and an obligation for him to receive from his customers. All looked at profit as something they would like to have more of, but were more or less reconciled to the feeling that there was something inherent "in our business" that prevented reasonable profits.

### Variations in Profit Ideas

It never occurred (and rarely does) to these competitors that the variations in ideals and ideas was responsible for the generally low price levels of their industry. Briefly these are:

1. When quoting on product using very cheap paper he readily underbid his competitors until from sheer self protection they arbitrarily met his prices.

2. Simply followed prices of others blindly, and hoped to make 10 per cent on his sales. He often shaded prices arbitrarily on the assumption that an extra 5 per cent off only meant a small reduction from his total profits and perhaps increased them by the increased volume of sales effected.

3 and 4. Had had the same cost system installed by the same accounting firm as his competitors but, because of differences in the actual invested capital and the common practice of profiting on total costs at the same percentage rate had become a party to a very vicious price warfare between them. One had already drifted into the hands of his bankers who were trying to extricate him from the mess. The other had practically exhausted reserves accumulated over years of sound conservative management.

5. Had developed exceptional ingenuity and resourcefulness in finding ways to buy materials below

the market, and in producing poor goods below the prices at which he sold them.

6. Just simply drifted with the tide of unfavorable prices, discouraged and disheartened over his seeming inability to make the business profitable.

These six are a fair representative cross-section of the entire industry of some 50 odd manufacturers. It is doubtful whether the industry as a whole made any profit over a period of several years. There had been several failures and liquidations but none of these helped the industry, as the equipment remained to be supplied with business by the new owners that eventually arose. Much of the product was sold at prices one-third less than fair to the producers, although some few items of small sale happened to hold up to excessive prices.

An educational campaign looking to the development of common ideals and applications of profits was tried and the reactions and responses were as varied as the types of people receiving the instruction; on the whole, however, definite progress has been made of substantial and permanent character.

### Two Examples Show Possibilities

One of these firms, at time of receiving instructions, was asked to quote on a large contract by a firm whose practice is to send out quotation requests to many producers simultaneously. Upon receipt of this request it was shown to the instructor with the remark, "Here is a sample of what I am up against. I know these people are sending this request to many of my competitors one or more of whom will quote below $0.20. I know I ought to get $0.25 and I suppose you'd say quote $0.25."

The instructor answered, "I don't know that $0.25 is the right price, but if I did I'd certainly quote it."

"Yes! but then I won't get the business."

"Oh! you want the business, do you? Then quote $0.15 so as to be sure to get it."

"Yes! but then I won't make any money."

"Well it is merely a choice between doing the work at a loss, or not doing it, with the possible alternative that you will get it at a fair price if you quote the latter."

A fair price was quoted and to the manufacturer's surprise the order was given to him. He remarked at the time, "I don't know what they are thinking of. I can buy that product under $0.20 yet he is willing to give me $0.25."

This occasion was no doubt a fluke, but it is surprising how often these flukes occur. The lowest price does not always tempt the trained buyer. It can even arouse suspicion as to quality.

Another of these firms when shown the folly of quoting uncalculated prices went to one of his largest and constant customers, placed his figures and entire story before him, advising that he was obliged to raise his price approximately 20 per cent, as he did not care to longer operate with no profit. The president of the buying firm listened to his story and commented to the effect that it was high time that that industry got a little sense. There was no need of goods being sold at a loss or without a fair profit. "However, I can't go over the head of my purchasing department or even instruct them to pay you 20 per cent more than we can buy the goods for elsewhere. I would destroy the discipline if I did. If you can sell them I will not interfere."

He was unable to sell the purchasing department so left his quotation for the next quarter's requirements and departed. Much to his surprise and gratification a few weeks later the contract came in accepted at the new figures.

This was not a fluke, and only confirms the assumption that fair-minded buyers have no desire to deal unjustly with their suppliers. The latter are usually at fault in pressing goods upon them at prices that do not bring a fair profit to themselves.

### Selling Price and Profit Have No Fixed Ratio

Then what should this profit be? What proportion of the selling prices?

Manufacturing profit has no fixed ratio to selling price, or to total cost. This can be more readily understood when one stops to consider the article a manufacturer has to sell.

A manufacturer is not a merchandizer of material and labor. He does not buy materials and labor as cheaply as he can, to sell them at as high a price as he can. What he is selling is ability and skill in converting certain materials into other forms or other materials desired by his customers. The manufacturer is selling the same thing that the professional man, the lawyer, doctor or engineer sells. There is just as much logic for the latter to base their charges on their invested capital, or living and operating expenses, as for the manufacturer.

What is a manufacturing enterprise but an aggregation of skilled workers and their equivalent in automatic machinery? It is their skill that is for sale and each unit brings a minimum definite profit.

When a toy-maker sets up to make toys he expects to earn enough to pay himself a living wage, cover all of his costs and leave a profit, say at least of $500, at the end of the year. As his business grows he takes on a partner and later they take on assistants who may not be toy-makers, but are quickly developed into experts at some one or more details of toy-making, so that in effect the enterprise is an aggregation of expert toy-makers. If one toy-maker should earn $500 per year, then 100 of them should earn not less than $50,000 per year.

The machinist or the optician might demand a higher profit each but there is a basis of profit that can be developed as common to any given industry. Automatic machines displacing workers should earn profits corresponding to these workers as the public gains by the cost reduction.

A case in point is that of an automatic machine that was designed to displace five workers, and at

same time perform better and more accurate work. The manufacturer of the machine had a rule of adding 25 per cent of costs to arrive at a selling price. The machine was to cost $1,000 to build. He decided to charge $1,250, but asked for confirmation of this price before quoting. His treasurer called in a consultant to ask if 25 per cent was an excessive profit, and was told that percentage had no bearing on profit except as a minimum gage.

"You are not buying and selling pig-iron, steel and labor, but your ability to design and build equipment of large economic value to your customers. If you are unable to measure the amount and value of your ability that has gone into the machine you can at least approximate its value to your customers in the economies it will effect, and thereby arrive at a price advantageous to both."

The price eventually placed on the machine was $3,900 instead of $1,250. These machines have sold steadily for the past three years, at prices ranging from $3,200 to $4,000 despite reduced costs, and despite competition from machines for the same purpose selling at $600 each.

Nor have these prices proven unduly profitable, but have enabled steady growth, development of improvements, extension of distribution abroad, and at the same time users find them very profitable as they save labor, space, investment in inventories, facilitate service, and increase profits by reductions in costs.

Had these machines been sold on basis of an arbitrary trading mark-up it is doubtful whether the company could have continued in business. The lower price in all probability would not have sufficiently increased business to justify it.

The purchasers of the machines should earn as much profit from them as formerly from the combined efforts of the people employed for the work.

### Low Costs May Bring Trouble

Firms that figure an arbitrary percentage mark-up on total costs or on labor costs find, of course, that the lower their costs the less they make. It is just the reverse of our famous war-time contracts of "cost plus" where the higher the costs the higher the total profit. Some concerns, using this practice over a long period of years, never give a thought to the possibility that it may account for their lessening profits. The more progressive they are the faster their ratio of profit to invested capital shrinks.

A case in point, that is not in any way exceptional, is that of one of our finest and soundest national enterprises, that found it necessary to call a halt on growth, on the supposition that a "law of receding returns" was operating against them, that they had already reached the saturation point in business volume and that more volume would mean less total profit as well as a lower rate of profit to capital invested.

This halt in total sales volume did not stop the recession in profits. Each year they continued less and even with a slight drop in sales volume they became still lower and eventually profits entirely disappeared.

A survey disclosed that the cause of the continued profit shrinkage was the continued progressiveness of the manufacturing department toward lower costs and use of the same, old, arbitrary mark-up rate on these costs for gross profit. Manufacturing costs eventually got so low that the mark-up just barely covered general overhead and selling expenses and left nothing for the stockholders. Although the same relative volume of units was sold the lowered prices due to lowered costs reduced total gross income as well as eliminating the net.

Many of our finest and soundest institutions are exactly in this same predicament and do not realize its cause; but attribute receding profits to unintelligent competition (which it is). Just now many are attempting to reduce this competition by consolidations or mergers that will reduce the number of firms that are making prices.

### The Fixed Percentage Habit

It is not unusual to find entire industries suffering from this long established habit of fixed percentage mark-up on costs. In one group surveyed, this practice was almost universal and, in many instances, the younger or newer firms were making very handsome profits while their older more established competitors were not.

There was even a strong suspicion in many minds that it was because of the old age of some of the firms that they were less profitable than the newer ones. A survey disclosed that the reason was due to changes in style of the women's wear produced by these firms. The greater volume had largely switched from cotton to silk garments.

The new firms had not bothered to produce cotton garments because of the small and receding demand, and in making up their cost sheets of labor, plus materials, plus manufacturing overhead, found that the spread between this total and selling prices to cover gross profit need be but 30 to 50 per cent.

The older concerns had become accustomed to adding 100 to 150 per cent on the cost of cotton garments and, of course, when they added this same ratio to silk, found that the newer firms were underbidding them. To make matters still worse, a few of the silk garment makers got after some of the remaining cotton garment business on the basis of their established profit rates and forced prices down on these already low priced goods.

These people gravely discuss their respective ratios of so-called overhead to total cost. The old firms express disbelief in the low ratios quoted by the younger firms. The latter get the idea that it is because of their superior efficiency that their ratios are low and their businesses profitable, while the "old fogy" concerns with their supposedly high-costs cannot compete with them.

The facts are just the reverse. The older concerns

are generally more efficient. They are cheaper producers and have less sales resistance because of established prestige. The trouble is chiefly due to the industry looking upon its activities as one of merchandizing cotton or silk and labor. The gross profit rate that is fair for silk is insufficient for cotton. A rate that would be fair for cotton is excessive for silk. If this industry based its profits on what it really sells—its skill as garment makers—it would not matter what materials were used.

### Cost Systems Not at Fault

Neither is it lack of knowledge of costs that makes the trouble. Several of these firms have installed a uniform costing system, and each one is able to get his manufacturing costs readily enough. The whole industry is affected by a faulty pricing policy, and a lack of common understanding of a few elementary principles in pricing. Instead of having a profit objective and including it in their prices, profits are subjective and due to accident in the class of goods handled.

There are many industries whose output is quite naturally measured in terms of weight. Here, very often, far too often in fact, the profit also is set on the basis of so much an ounce, a pound or ton. This is especially apt to be the case in metal and paper industries and often accounts for the mysterious profits of apparently inefficient and badly managed enterprises, and the equally mystifying deficits or meager profits of exceptionally well-managed concerns.

As a general rule the producers of the coarser sizes of metal goods, paper, and fabrics, sold on a weight basis, offer greater opportunity for profit than the finer sizes. This is true even when goods are classified and different prices used for each class.

### Pound Price Fallacy

One recent survey of a steel product industry disclosed that prices per pound ranged from $0.09 for the coarsest to $0.32 per lb. for the finest. It was found that $0.07 was ample for the coarsest sizes while the finest needed $0.60. Our old friend "the law of average" that was supposed to take care of any inequities in these prices failed to do so. The consuming trade gradually changed its requirements to the finest gages it could possible use, so that today the total weight for the total number of units sold is very much less than it was a few years ago. More and more of the $0.60 goods are bought for $0.32 and less of the $0.07 goods are bought for $0.09. A few firms specializing on the coarsest sizes make quite reasonable profits, while the few who specialize on fine goods are in desperate straits to make ends meet. All from a lack of proper concept of what profits should be; not from lack of knowledge of costs.

The habit of pricing on weight goes to what seems absurdities to the lay mind. From rivets to steamships, from the making of castings to the erection of skyscrapers, manufacturers, contractors, architects and engineers quote and price on a basis of so much per ounce, pound, hundredweight or ton.

This method is just one more fallacy in the general chaos of ideas on "what the profit should be."

In many industries, where prices per pound may be quite varied over the different gages, sizes, etc., it is quite common to find profit considered on a single rate basis. Thus a foundry will say, "We ought to make $0.02 a pound profit"; or a paper mill making different calipers of paper will figure the same way. If castings average heavy, the foundry profits; if light, it loses, even though the plant is equally busy under both extremes.

It is not unusual to find in the same industry one manufacturer adding a fixed rate per pound to his costs for profit and selling price, while another adds a fixed ratio of costs for the same purpose. The inevitable result is that the entire industry is forced to sell at prices that represent the lowest arrived at by either of the methods. Thus: "A" may figure that his costs run from $0.08 per lb. to $0.16 per lb. for his different grades, and that his profit should be 50 per cent, making prices from $0.12 to $0.24. "B" also figures costs as $0.08 to $0.16 and his profit as $0.06 per lb., giving him prices from $0.14 to $0.22. The result is that both get from $0.12 to $0.22.

When you take the modifications and possible elaborations of these variations in pricing principles into account it is little wonder that prices of competitive commodities and on competitive contracts are as varied as they are. Any industrious purchasing agent or customer can get quotations for the same products in many lines that will be astonishingly far apart. Quotations of $0.18 to $0.40 per lb. for the same castings are not unusual.

No such differences in actual costs or in needed selling prices are credible. The differences are chiefly due to differences in profit ideals and in profit application. Having no common understanding as to what the profit should be, and upon what it should be based, the firms making the greatest errors against themselves get the most business. Hence the high business mortality rate in this class of industries.

### An Example of Improvement

A survey of prices established by six competitors disclosed differences as great as 35 per cent between quotations for the same staple products. When these six firms had adopted and applied uniform principles for pricing, the maximum difference found in any one of several hundred items checked for price was but 5 per cent.

With the chaotic pricing ideas, ideals and methods now characteristic of manufacturing activities, the only surprise is that even 30 per cent of them show anything like a reasonable profit for their owners or stockholders. The cure for this condition is in the application by members of an industry of a few elementary principles in pricing. Among these is how to determine "what the profit should be."

# Summarizing Costs for the Directors

## Practical Methods of a Small Factory

By RUDOLPH ROSENTHAL

*Treasurer, Jacques Kahn, Inc.*

A DESCRIPTION of the details of the cost system of a small factory upon which this article is based appeared in earlier issues of this magazine.[1] This system has proved to be very practical. A few important details have now been added and improvements made in the presentation of the monthly results.

This article, therefore, only gives a general review of the work of compiling the production and cost figures for the monthly closing, and then explains more explicitly how the final presentation of them is worked out.

The object is to prepare each month a report to the board of directors in the form of an "Analysis of the Operating Profit or Loss" explaining the reasons, why from the production point of view, profits are larger or smaller than estimated or anticipated.

The presentation of changes in the financial relationships, taken from the monthly bookkeeper's statement, and a detailed sales analysis, of course go parallel with the cost accounting report.

[1] See articles in this journal by Geoffrey C. Brown, March, April, May and June 1924, and by the author in March, May and June, 1925.

Before describing some of the features of this profit or loss analysis it is helpful to turn to the two charts (Figs. 1 and 2) which show how the cost data are compiled. Thus a review may be had of the whole system, without going into too many details.

This particular factory does not produce for stock, but manufactures on customers' orders only. Each order is a different one as to quantity, sizes of units, material, manufacturing cost and price, although the character of the raw material varies but little, the operations are few and the classes of articles are limited.

### The Cost Sheets

The direct source for accumulating the monthly cost data are, therefore, the cost sheets for the individual orders, as shown in the earlier articles.

Fig. 1 explains from which sources the data for the cost sheets are collected. The top of the chart indicates the headings of the cost sheet, under which the information has to be filled in. Below are given the sources which produce the demanded data. These sources are tickets, forms and tables listed in the following items A to L inclusive:

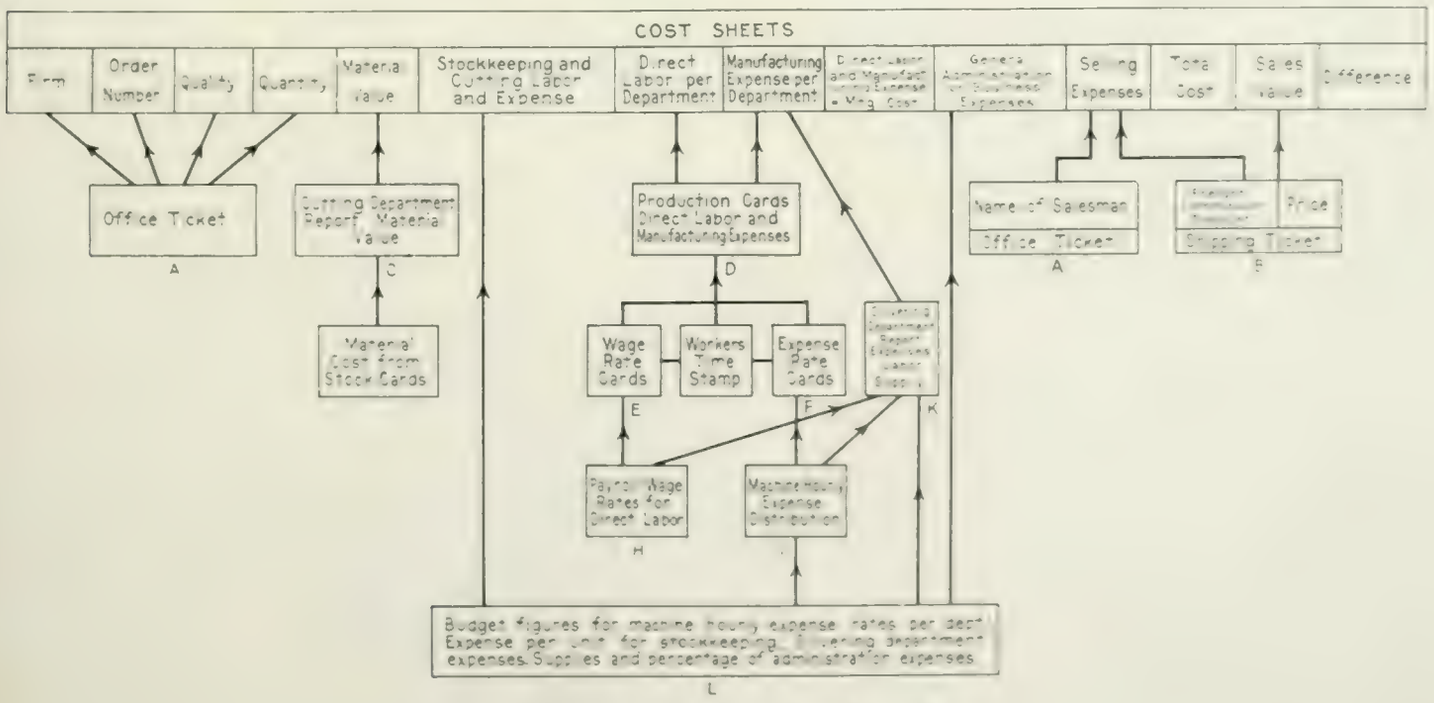


Fig. 1 Origin and Flow of Cost Sheet Data

*A. Office Tickets.*—The factory orders are made out in five copies (the cutting, manufacturing, shipping, office and reference or scheduling tickets). From the Office Ticket the cost clerk enters the customer's name, order number, quality and quantity, as well as the initials of the particular salesman.

*B. Shipping Ticket.*—From the figures on this, the Shipping Ticket, which is used for billing purposes, information for the cost of stockkeeping (a rate per unit), for the supplies of the silvering department, and for the administrative or business expenses (a percentage based on manufacturing cost.)

Fig. 2 indicates a chart on which all the sources are shown for the data needed for the entries on the Monthly Profit or Loss Statement and on the quality analysis, shown in Tables 1 and 2. At the end of

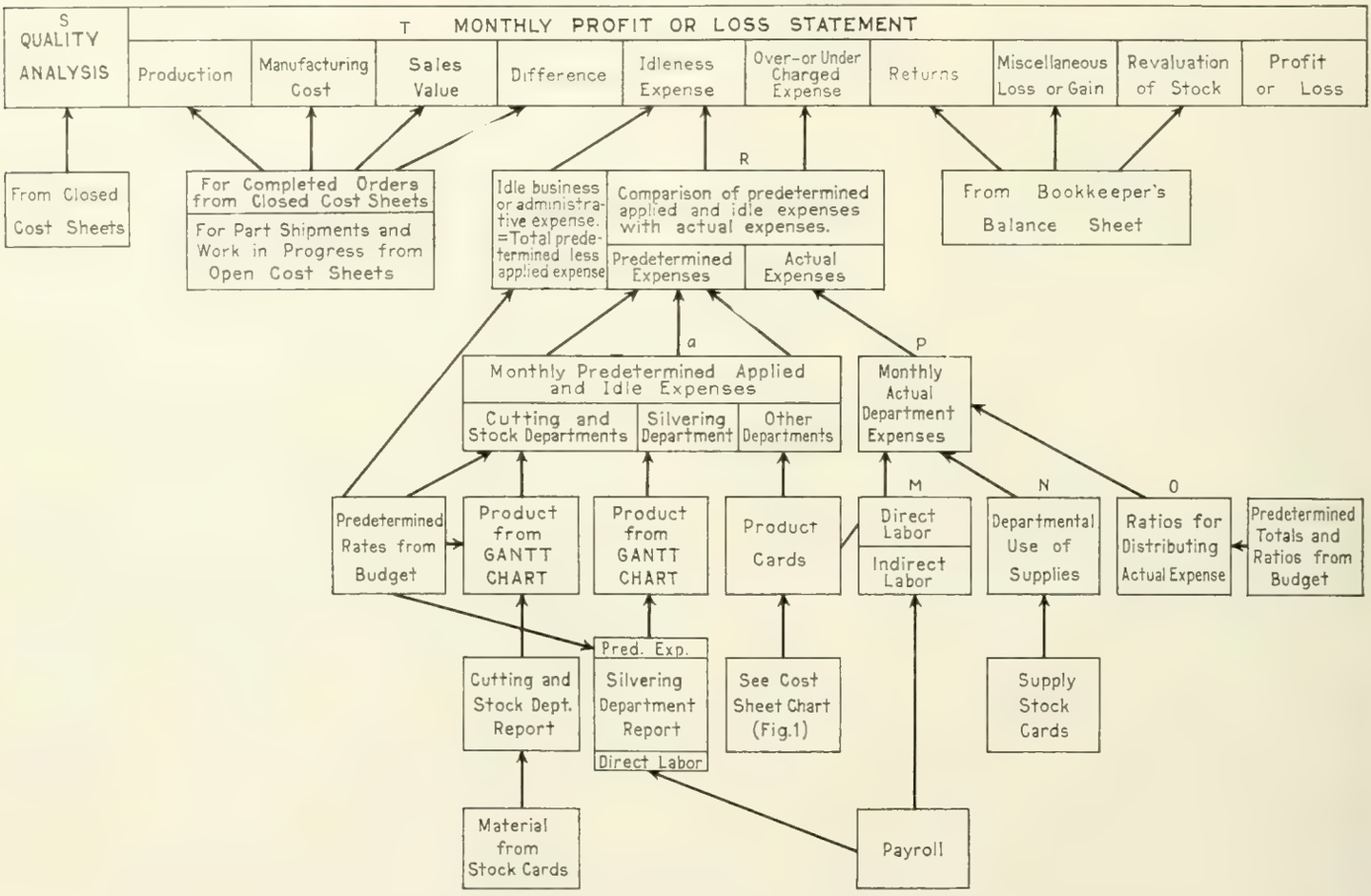


FIG. 2 COMPILATION OF DATA FOR MONTHLY PROFIT OR LOSS STATEMENT

the price and freight amounts are copied, and commission and cash discount are figured.

*C. Material Cost.*—The Material Cost Report supplies the cost of the material for the individual cost sheet.

*D. Production Cards.*—The production cards are filled in by the individual workmen. They register for each other how much time was spent on a particular machine and the corresponding amount of wages, and machine hourly expense.

*E. and F. Rate Cards.*—The rate cards are used by the cost clerk to figure wage and expense items.

*H. and I. Payroll and Expense Distribution.*—The payroll and machine hourly expense distribution tables give the information for the rate cards.

*K. Silvering Department.*—The silvering department, on account of the interchanging activities of the workers, has to be treated as one machine and the supplies are of relatively high cost.

*L. Budget Tables.*—The budget tables supply the the month the last cost sheets are taken off the file, which represent completely filled orders. The items on them and those on the filled order sheets taken out during the month are added, and their totals are entered on these two lists. These are the closed cost sheets, while those left on file are called the open cost sheets. The letters on the charts, Figs. 1 and 2, represent lists in a looseleaf closing book, on which the information is entered monthly, with the exception of list No. O, which is a permanent one, containing distribution ratios, which are permanent, subject, of course, to periodical changes. We only reproduce here the final two lists, S and T, as Tables 1 and 2, respectively.

### MONTHLY PROFIT OR LOSS STATEMENT

The list shown in Table 1 gives the monthly closing figures of the cost department. These totals ought to be approximately the same as the totals of the bookkeepers' income statement. On account of differences in time, adjustments of all kinds, variations in

TABLE 1 MONTHLY PROFIT AND LOSS STATEMENT

| | COST OF SALES | | | | | COST OF PRODUCTION | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Completed Orders | Part Shipped Last Month | Part Shipped This Month | Total Cost of Sales | Unit Size and Cost | Work in Progress First of Month | Work in Progress End of Month | Total Cost of Production | Unit Cost |
| Plates | 870 | 47 | 185 | [illegible] | 4.3 sq. ft. | [illegible] | [illegible] | [illegible] | [illegible] |
| Square Feet | 25,029 | 288 | 1,031 | [illegible] | | [illegible] | 10,277 | 25,646 | |
| Material | $17,123 | $[illegible] | $1,024 | $17,842 | $0.69 | $ 7,703 | $ 8,923 | $[illegible] | $[illegible] |
| Stockkeeping | 2,002 | 25 | 83 | 2,062 | 0.08 | [illegible] | [illegible] | 2,051 | [illegible] |
| Direct Labor | 2,463 | 27 | 99 | 2,535 | 0.10 | [illegible] | [illegible] | 2,556 | [illegible] |
| Manufacturing Expense | 4,684 | [illegible] | 284 | 4,953 | 0.19 | [illegible] | [illegible] | 5,100 | 0.20 |
| Business Expense | 2,144 | 13 | 115 | 2,246 | 0.09 | 416 | [illegible] | 2,317 | 0.09 |
| Selling Expense | 1,986 | 22 | [illegible] | 2,027 | 0.08 | | | | |
| Total Cost | $30,402 | $[illegible] | $1,698 | $31,685 | $1.23 | $10,408 | $11,856 | | $1.22 |
| Sales Value | 34,225 | 471 | 1,780 | 33,866 | 1.31 | | | | |
| Difference | $ 2,823 | $ [illegible] | $ 112 | +$ 2,181 | +$0.08 | | | | |
| Idleness Expense | | | | 720 | 0.03 | | | | |
| Difference between Actual and Predetermined Expense | | | | + 211 | + 0.01 | | | | |
| Rebates | | | | 87 | | | | | |
| Miscellaneous Loss or Gain | | | | + 213 | + 0.01 | | | | |
| Profit or Loss | | | | +$ 1,798 | + 0.07 | | | | |

predetermined costs and expenses, small differences, of course, occur. The figures at the top of this statement represent production, the others values. The cost of sales and the sales value are obtained by adding up, first, all the different production and cost items on the closed cost sheets as taken from the file. Second, as part of the orders represented by these cost sheets have been shipped and accounted for in previous month, their cost and value have to be deducted from the current month figures. Furthermore the open cost sheets left on file show part shipments made during the current month, and their figures have to be added. The result is the actual cost of sales.

From the resultant gross operating profit on sales the cost of idleness (or unapplied expense) has to be deducted, or if a loss is shown, it has to be added. The idleness is accumulated on a list, R, as indicated in Fig. 2. This same list (not reproduced here) shows over- or under-applied expenses, that is, the difference between actual expenses and the total manufacturing expenses applied through the machine hourly rates. This difference also has to be added or deducted from the profit or loss. The monthly profit or loss statement, Table 1, is also used to get the unit figures

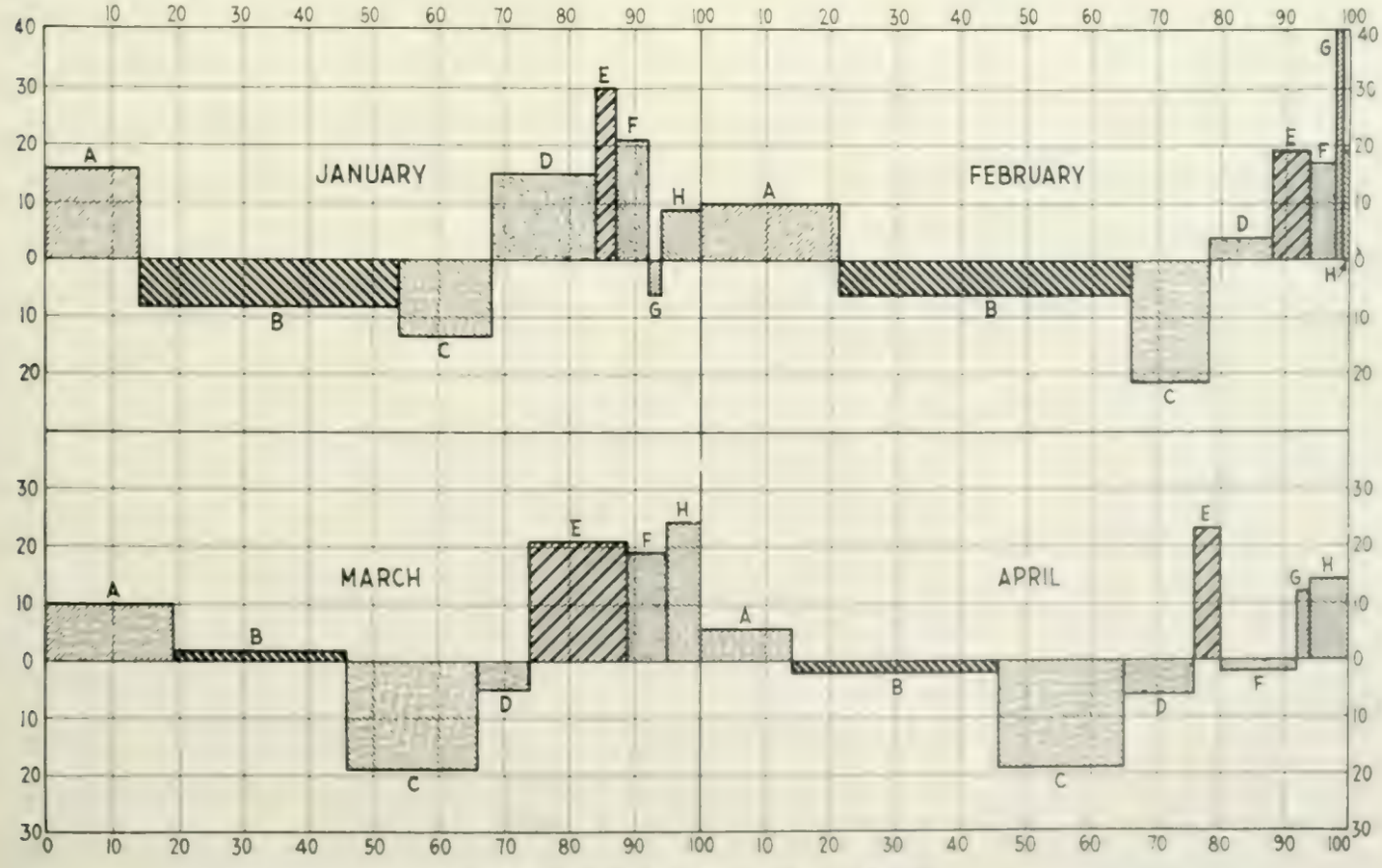


FIG. 3 PERCENTAGE OF QUANTITY AND PROFIT

TABLE 2. MONTHLY QUALITY ANALYSIS OF COMPLETED ORDERS

| QUALITY | PROFIT ORDERS | | | | LOSS ORDERS | | | TOTAL ORDERS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sales | Cost | Profit | Profit Per Cent | Sales | Cost | Loss | Sales | Quantity Per Cent | Cost | Profit or Loss | Profit Per Cent |
| A | $ 3,843 | $ 3,064 | $ 779 | 20 | $ 734 | $ 779 | $ 45 | $ 4,577 | 14 | $ 3,843 | $ 734 | 16 |
| B | 2,806 | 2,354 | 452 | 16 | 9,351 | 9,752 | 401 | 12,157 | 38 | 12,106 | + 51 | |
| C | 244 | 234 | 10 | 4 | 4,134 | 4,708 | 574 | 4,387 | 14 | 4,942 | − 564 | −13 |
| D | 3,340 | 2,216 | 1,124 | 34 | 1,502 | 1,883 | 381 | 4,842 | 15 | 4,099 | + 743 | 15 |
| E | 1,130 | 786 | 344 | 30 | 20 | 24 | 4 | 1,150 | 3 | 810 | + 340 | 30 |
| F | 1,267 | 994 | 273 | 21 | 257 | 287 | 30 | 1,524 | 5 | 1,281 | + 243 | 16 |
| G | 1,991 | 1,601 | 381 | 14 | | | | 1,991 | 6 | 1,610 | + 381 | 19 |
| H | 1,423 | 1,301 | 122 | 9 | 183 | 409 | 226 | 1,606 | 5 | 1,527 | + 79 | 5 |
| Total | $16,044 | $12,559 | $3,485 | 22 | $16,181 | $17,842 | $1,661 | $32,225 | 100 | $31,218 | $1,007 | 6.2 |

TABLE 3. PERCENTAGES OF QUANTITY AND PROFIT

| MONTH | QUALITY A | | QUALITY B | | QUALITY C | | QUALITY D | | QUALITY E | | QUALITY F | | QUALITY G | | QUALITY H | | TOTAL | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity Per Cent | Profit Per Cent | Quantity Per Cent | Profit Per Cent | Quantity Per Cent | Profit Per Cent | Quantity Per Cent | Profit Per Cent | Quantity Per Cent | Profit Per Cent | Quantity Per Cent | Profit Per Cent | Quantity Per Cent | Profit Per Cent | Quantity Per Cent | Profit Per Cent | Quantity Per Cent | Profit Per Cent |
| January | 14 | 16 | 40 | − 8 | 14 | −13 | 16 | 15 | 3 | 30 | 5 | 16 | 2 | − 6 | 6 | 19 | 100 | +2.6 |
| February | 21 | 10 | 43 | − 6 | 12 | −21 | 10 | 4 | 6 | 19 | 4 | 17 | 1 | 40 | 1 | 24 | 100 | −0.5 |
| March | 19 | 10 | 27 | + 2 | 16 | −24 | 12 | − 5 | 15 | 21 | 6 | 19 | | 14 | 5 | 20 | 100 | +3.2 |
| April | 14 | 16 | 32 | 12 | 19 | −18 | 17 | 0 | 4 | 23 | 12 | 3 | 2 | 12 | 6 | 14 | 100 | +4 |
| May | 20 | 17 | 39 | 8 | 9 | − 9 | 16 | −12 | 8 | 24 | 6 | 20 | 1 | 23 | 1 | 27 | 100 | +6.9 |

for production and cost. The units of production are in this case plates and square feet of glass. Each cost sheet shows the number of plates and square feet. Dividing the total plates of each of these two groups by the corresponding total of square feet, the average size of the plate sold is obtained. The cost and price figures of the totals divided by the square feet give the unit costs and prices per square foot.

This monthly closing statement is furthermore used to find the work-in-process value. The latter is figured by adding up the production and cost items on the open cost sheets left on file. It is given to the bookkeeper as an inventory value for his statement.

Lastly, the work-in-process figures serve to get the actual production and its costs, which in some months will vary greatly with the production sold and its cost. The sales of the month naturally contain items which were already wholly or partly finished at the first of the month and not produced during the month. Their figures have to be deducted from the monthly cost of sales total. Many items though were wholly or partly finished and, therefore, produced during the month but not shipped, their figures, therefore, have to be added to the cost of sales, the result being the actual production and its cost. From the totals the unit sizes, costs and price are again obtained and listed.

### QUALITY ANALYSIS OF COMPLETED ORDERS

This list is shown in Table 2. It is made up by sorting the closed cost sheets as to quality and as to whether they show profits or loss orders. Percentages as to quantities and as to profit are also entered.

The picture given by this table is completed by the density chart, as developed by W. N. Polakov,[2] showing for each quality, how many and which were the good and bad orders, how far the extremes go and at which percentages the majority ranges. This chart also permits us to judge if the small or the large order was the more profitable one in each group.

It is very important for the final analysis to show

TABLE 4. DETAILED QUALITY ANALYSIS

| MONTH OF..... | | QUALITY A | QUALITY B | QUALITY C |
|---|---|---|---|---|
| Units Production | | 2,887 | 5,871 | 10,266 |
| Totals | Material | $2,262 | $4,920 | $5,879 |
| | Stock keeping | 173 | 352 | 616 |
| | Direct Labor | 239 | 295 | 447 |
| | Manufacturing Expense | 669 | 1,079 | 1,870 |
| | Business Expense | 272 | 412 | 695 |
| | Selling Expense | 290 | 409 | 685 |
| | Total Cost | 3,905 | 6,967 | 10,192 |
| | Total Price | 4,834 | 7,375 | 9,624 |
| | Difference | $ 929 | $ 408 | −$ 568 |
| Unit Price, Margin and Mfg Cost | Price | $1.67 | $1.25 | $0.94 |
| | Less Selling Expense | 0.10 | 0.066 | 0.068 |
| | Net Price | 1.57 | 1.184 | 0.872 |
| | Less Material | 0.78 | 0.75 | 0.57 |
| | Margin | 0.79 | 0.434 | 0.302 |
| | Stockkeeping | 0.06 | 0.06 | 0.06 |
| | Direct Labor | 0.083 | 0.05 | 0.043 |
| | Manufacturing Expense | 0.233 | 0.184 | 0.182 |
| | Business Expense | 0.095 | 0.07 | 0.067 |
| | Total Cost | 0.471 | 0.364 | .352 |
| | Difference | 0.319 | 0.07 | 0.05 |
| | Per Cent of Price | 19 | 5.6 | −5.3 |

[2] See article on density chart by W. N. Polakov in this journal.

TABLE 5. TOTALS MANUFACTURING MARGIN, COST AND PROFIT

| Month | Value of Sales | Sales Expense | Net Sales | Material | Margin | Direct Labor | Mfg. Exp. | Depr. | Manufacturing Cost | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | $12,543 | [illegible] | $4,953 | [illegible] | [illegible] |
| [illegible] | 24,[illegible] | [illegible] | [illegible] | [illegible] | 12,651 | 12,033 | [illegible] | [illegible] | 2,294 | 9,941 |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 13,428 | 3,238 | 5,156 | 2,518 | 10,912 |

TABLE 6. UNITS MANUFACTURING MARGIN AND COST AND PROFIT

| Month | Value of Sales | Sales Exp. | Net Sales | Material | Margin | Direct Labor | Mfg. Exp. | Depr. | Manufacturing Cost | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| [illegible] | $1.26 | [illegible] | $1.18 | $0.69 | $0.47 | $0.10 | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | 1.37 | 0.09 | 1.28 | 0.78 | 0.50 | 0.11 | 0.21 | 0.09 | 0.41 | 0.43 |
| [illegible] | 1.43 | 0.08 | 1.35 | 0.76 | 0.59 | 0.14 | 0.23 | 0.11 | 0.48 | 0.48 |

the composition of the monthly sales. Therefore the percentages are noted of the part each quality represents in the total sales of the month, and next to it what the profit or loss percentage was of the particular article. See Table 3. Fig. 3, the chart for percentages of quantity and profit, shows this analysis arranged for final presentation. It tells at a glance the percentage sold of each quality and at what profit or loss percentage the sales were made. Grouping four months on one sheet gives a picture for a longer period. The areas represent the relation of the profit of each quality to the total sales.

TABLE 7. MONTHLY COST DEPARTMENT REPORT

| | | Value | | Comparative Analysis | | Remarks |
|---|---|---|---|---|---|---|
| | | This Month | Last Month | This Year | Last Year | |
| Totals | Production | 24,117 | [illegible] | 22,713 | 20,111 |
| | Sales | $30,819 | [illegible] | $28,[illegible] | $24,680 |
| | Profit or Loss | 482 | 1,798 | 673 | [illegible] |
| Units | Net Price | $ 1.28 | $ 1.31 | $ 1.27 | $ 1.23 |
| | Less Material | 0.70 | 0.69 | 0.66 | 0.73 |
| | Margin | 0.58 | 0.62 | 0.61 | 0.50 |
| | Less Mfg. Cost | 0.53 | 0.54 | 0.55 | [illegible] |
| | Difference | 0.05 | 0.08 | 0.06 | 0.03 |
| | Less Distress Expense | 0.02 | 0.01 | 0.03 | 0.05 |
| | Net Operating Profit | 0.03 | [illegible] | 0.03 | −0.02 |

Factors Affecting Comparisons on Lines above Last Margin

| Unit | Causes of Favorable Increases | Causes of Profit Decreases |
|---|---|---|
| Production | | [illegible] |
| Net Price | | No change in prices, but relative [illegible] |
| Material | | [illegible] |
| Margin | | [illegible] |
| Manufacturing Cost | [illegible] machine | |
| Distress Expense | | [illegible] |
| Net Operating Profit | | [illegible] |

## Detailed Quality Analysis

At monthly periods the analysis shown of Table 3 is supplemented by a more detailed statement as shown on Table 4, the statistics being taken from the monthly closed cost sheets.

The average unit production cost figures per quality are used to check the standard production cost figures for the different qualities and other subdivisions, as received by direct methods (time study) and used for estimating purposes.

## Total and Unit Manufacturing Margin and Cost

Two factors mainly influence the operating profit. The one is the manufacturing margin, the other is the amount of sales or resultant production.

As in many industries, so also in this, the manufacturing cost remains relatively constant, varying somewhat, of course, with the amount or volume of production. The manufacturing margin though, the difference between raw material cost and [illegible] finished production, is subject to considerable ups and downs. The operating profit will, therefore, depend largely on the margin figures.

For the purposes of the analysis of the monthly profit average of all qualities the list for Totals of Manufacturing Margin, Cost and Profit (see Table 5)

[illegible] May 1925 [illegible]

gives the margin figures as taken from the closed cost sheet totals. This table also shows the monthly idleness cost and other deductions from profit (such as expense corrections, returns, etc.)

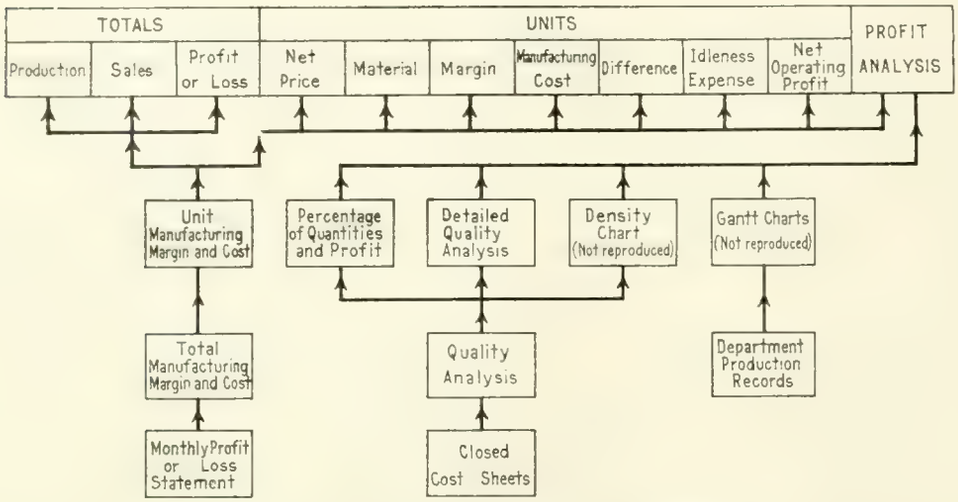


FIG. 4 MONTHLY COST DEPARTMENT REPORT

In Table 6, the units of manufacturing margin, cost and profit are shown in the way in which the unit figures are listed. They are received by dividing the total amounts in Table 5 by the production total.

The final report is shown in Table 7, which is a short review of the results shown on those previously presented. A chart, Fig. 4, shows how these results are accumulated. This Cost Department Report is accompanied by two ratio charts which are not reproduced, but which permit us to compare the monthly sales, production, unit price, margin and cost with each other. One of these contains some of the factors making up the manufacturing cost, permitting to read the influence of the percentual increase or decrease of production on the cost of the different items.

Periodically the Cost Department Report is supplemented by charts showing cumulative totals, and indicating the trends in prices, production, margins and costs.

# Two Novel Material Handling Methods

TWO examples of an ingenious solution of a material handling problem are shown in the accompanying views.

The Sperry Flour Company, large manufacturers of flour, operates low bed, large capacity trucks for handling its products. Each is provided with a special end gate, as shown in Fig. 1, which can be lowered so that it will reach to and touch the pavement. This simple device has cut the time of loading and unloading the trucks, and reduced the amount of labor necessary for these two operations. The end gate is raised and lowered by means of a rope and tackle attached to the side of the truck body.

FIG. 1 SPECIAL END GATE CUTS TIME OF LOADING TRUCKS

The second unusual but effective material handling method has been developed and used by the Fageol Motors Company. It is shown in Fig. 2. Three trucks are arranged in what might be called "superimposed tandem." The driver operates the first truck in the usual way. Upon the rear of this truck the second is mounted so that the front wheels are off the ground and the rear wheels trail. The third truck is mounted on the platform of the second. In this way one driver is able to transport and deliver three trucks.

FIG. 2 METHOD OF TRANSPORTING AND DELIVERING THREE TRUCKS

# Simplified Production and Handling

## Methods of Kelly Press Based on Classification of Work in Round and Flat Groups

By H. H. EDGE

*Works Manager, Kelly Press Division, American Type Founders Company, Elizabeth, New Jersey*

WHILE the completed presses manufactured by the Kelly Press Division of the American Type Founders Company[1] are fair-size machines, ranging in weight from about 4000 lb. to 10,000 lb., each depending on the type, all require accurate machining, and some parts a high degree of accuracy and workmanship. This, of course, calls for frequent

FIG. 9 LOCAL INSPECTION ON ROUND WORK IN GEAR DEPARTMENT

and very careful inspection and test. In such work the local operation system is employed, and at various points special testing equipment is installed so that inspection is made progressively as required, and where the work is being done. Thus again trucking and delay are eliminated, and the flow of material has no set back. See Fig. 9.

This inspection is of course, so organized and centrally supervised as to insure uniformity and full accuracy. It is also found that the operatives work better in this manner, for the importance, reality and fairness of the tests are appreciated because close at hand, and it becomes a personal matter far more so than when their work is passed on to a distant and impersonal inspection at some remote place and time. Also, defective material and workmanship are detected or corrected earlier, and fewer rejections result.

At various points throughout the machining and inspection departments, racks are provided to hold tote pans for defective or salvageable parts. Containers for spoiled or waste parts that cannot be salvaged are painted red, while those for parts that can be salvaged are painted green. Containers for rejected work that is to be charged back to foundry or vendor are painted blue.

At stated intervals such material is collected, and after examination for report or charging, spoiled parts are scrapped and parts suitable for salvage are passed to the Salvage and Reclamation Department (Section 26 in Fig. 13).

In like manner the Stores or Stock Department is decentralized to a greater extent than usual, and through close co-operation material handling is reduced, for it is much simpler and more efficient to stock completed process parts convenient to their next operation, than to convey them to a distant central point, only to bring them back to almost their original location at some later date. Of course this decentralization of stores is less important in a small product of light weight, even though it may involve a large number of very small parts.

It is obvious that in some cases, say the manufacture of an adding machine with an annual output

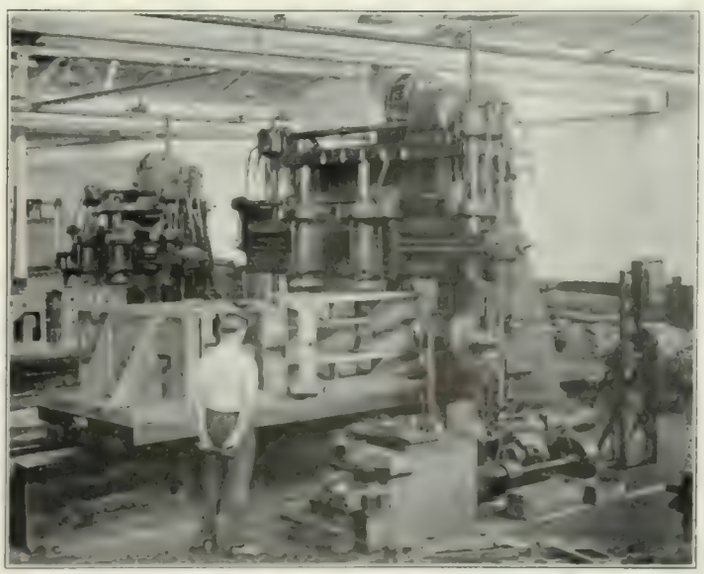

FIG. 10 LATHE CHUCKS—FLAT WORK IN HEAVY MILLING DEPARTMENT

[1] See February 1926 issue of MANUFACTURING INDUSTRIES, pp. 93-6, for first section of this article.

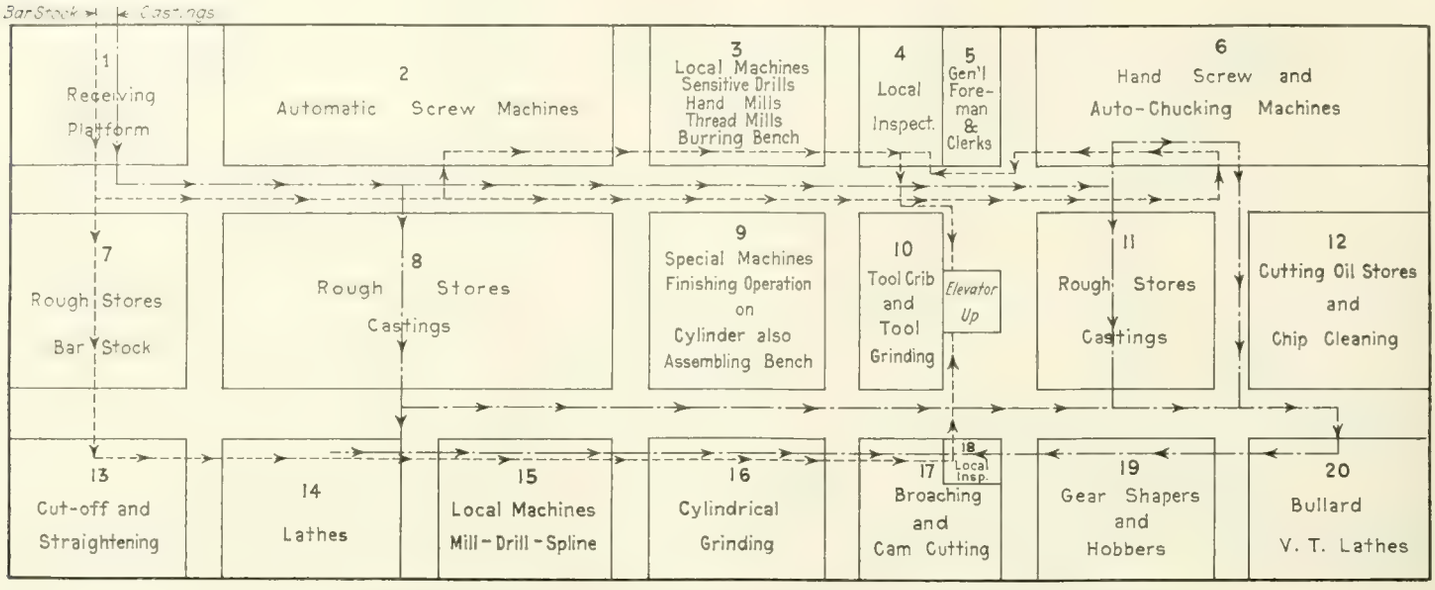


FIG. 11 DIAGRAMMATIC PLAN OF FIRST FLOOR WHERE ROUND WORK IS PRODUCED

of 100,000 machines, the entire year's supply of one small part might be handled on one truck. Likewise it is equally obvious that in the case of a sizable machine with an output of 10 per day, each base would require a truck. This comparison again brings out the advantage of distributed stores, inspection and the progressive plan of machining described.

The product of the company is standardized, and consists of only three types of presses. These are known as the Kelly Automatic Jobber weighing 4000 lb. and capable of running off 4500 sheets, 16 by 21½ in., per hr.; Style B Kelly Special, with a net weight, including extension delivery, of 4820 lb. and capable of running 3600 size 17 x 22 in. sheets per hr.; Kelly Automatic No. 2, running at 3000 impressions per hr. and having a net weight of 10,150 lb.

The design and construction of all of these presses are such that many parts are standard for all three types. Also it is possible to employ sub-assembly of certain elements.

Sub-assemblies are grouped on the third floor, and when completed are lowered by elevator to the second floor where the presses are erected. The second floor is the receiving and shipping level. Here prescribed running adjustment and printing tests are made, after which the presses are knocked down to whatever extent is necessary, this also being standardized. The parts and sections are then delivered directly to the Boxing and Shipping Department which is convenient, and also adjacent to the shipping track.

Throughout assembly, both sub- and general, the same plan of progressive work is followed, so that handling is reduced to a minimum.

All Kelly presses are self-contained electric-motor-driven, but a wide variety of motors is necessary because the presses go to customers all over the world, where every possible kind of electrical condition is encountered. As it is important that the presses be tested under conditions identical with those under which they will ultimately operate, there is provided a very complete change-over switchboard with leads running to all assembly test positions, so that any kind or condition of current can be delivered at any assembly station.

In this way, one press may be running on 110-volt direct current, while the adjacent press will be on a 220-volt single-phase alternating current, and the next one on 440-volt direct current.

The changing over from standard electrical current conditions, as furnished by the local Public Service Company, to the many electrical conditions required, is effected through an equipment of transformers and rotary converters, and a switchboard in Section 33 of Fig. 13, convenient to the various testing stations.

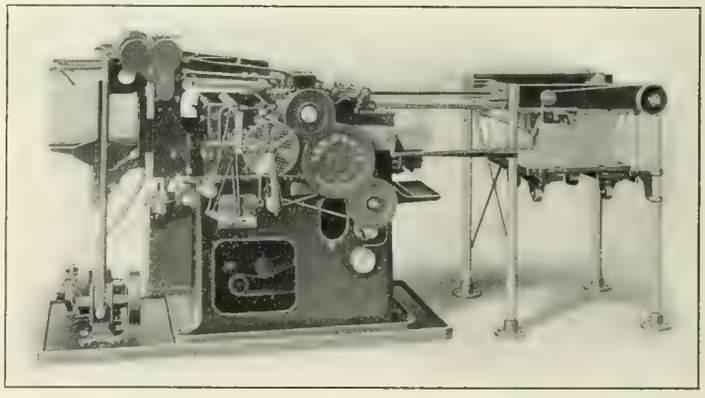

FIG. 12 STYLE B—KELLY AUTOMATIC PRESS WITH EXTENSION DELIVERY

From this point to all positions on the several erecting and testing floors (Sections 22, 23, 24 and 32 in Fig. 13) three-wire cables are led through conduits concealed in the floor. At points where the cables emerge they are carried overhead by a swinging pipe davit or boom, which contains a three-wire flexible cable with a hanging length about head high, ending in an insulated plug block. In this way the motor of a press can be instantly connected and any kind of current, D. C. or A. C., any voltage and any cycles,

or any phase can be thrown on, according to needs.

Of course no general rule for applying the system can be laid down to fit all cases. Each complete product and in fact each individual piece must be studied to determine just how far the method can be applied. Nor is any claim made to entire originality for the system, because other plants are using this plan to some degree. It is mentioned here to demonstrate that the Kelly Press factory has found it most satisfactory in its case, to reduce costs and increase production in the manufacture of a standardized line of machinery of fair size, ranging in weight from about 4000 to 10,000 lb. No doubt other manufacturers with rigid departmental methods could employ the system to equal advantage, if a study of their products were made with this idea in mind.

To show the actual application of this system in detail, the following illustrations of the departmental layout of the Kelly Press Division of the American Type Founders Company will be helpful.

Fig. 11 represents the first floor. This is on the actual ground level, but below the receiving track which is on the second floor, due to the railroad being elevated. This entire floor, Fig. 11, is devoted to "round work." The machine tools, equipment and stores are so placed as to provide two broad and direct main aisles, and as many narrower but direct cross aisles, as needed for accessibility to all tool sections.

The type of equipment and general character of work performed in each section were pictured in the illustrations Figs. 1 to 8 in the previous article. The numbers 1, 2, etc., shown in Fig. 11, are introduced for purpose of explanation.

All rough stock requiring round operations, at least to a major extent, is placed on this floor convenient to the departments in which the primary operations are started. In the illustration there are shown two routing lines, one for bar stock, a dotted line, the second for castings, a dash-dot-dash line. These both start at the left with the receiving platform (1). All castings are delivered to the plant by truck from a contract foundry. Bar stock, when received by railroad, is unloaded from the car at the second floor level on a truck and carried around to the receiving platform (1) where it is placed in Rough Stores Bar Stock (7).

As required on production orders, it is cut and ground, or finished to exact length, and carefully straightened in the Cut-Off and Straightening Department (13). All centering of bar stock is also done at one point before passing to lathes, etc., as it has been found that this exact cutting and straightening saves considerable machine time and wastage in machining departments. Bar stock for Automatic (2) and Hand (6) screw machines passes directly to these departments as required. It will be noticed that after leaving the automatics (2) such parts as require drilling, tapping or hand milling enter directly what is

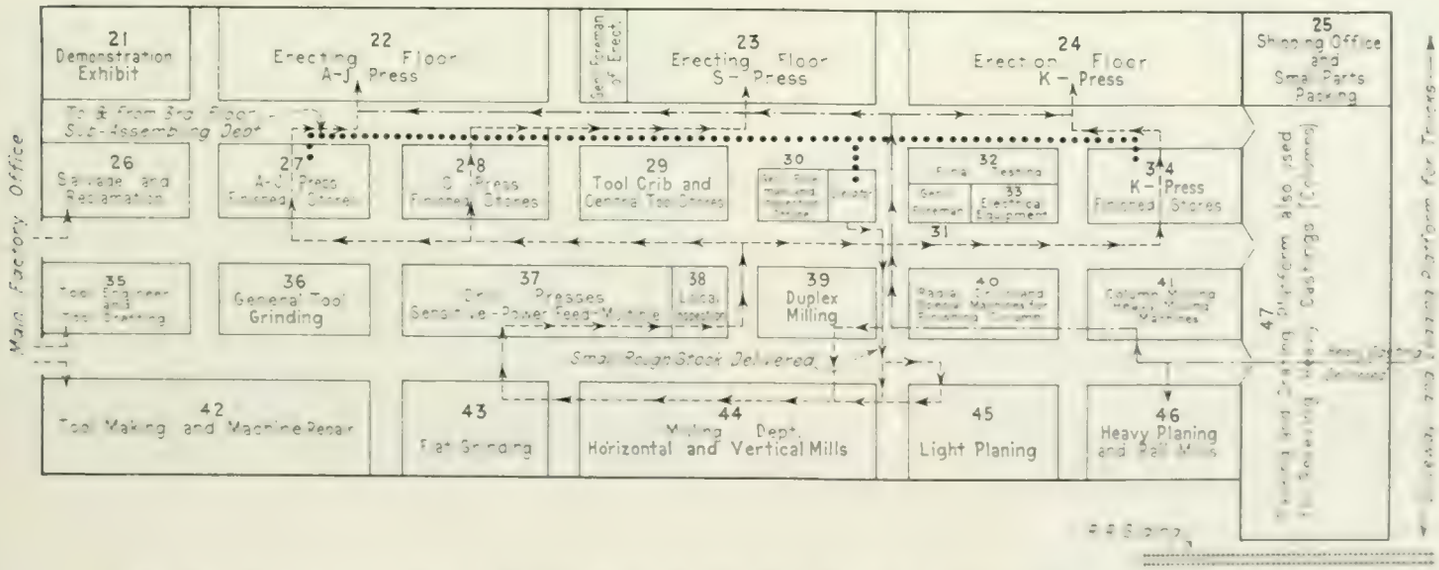
21 Demonstration Exhibit
22 Erecting Floor A-J Press
23 Erecting Floor S-Press
24 Erecting Floor K-Press
25 Shipping Office and Small Parts Packing
26 Salvage and Reclamation
29 Tool Crib and Central Tool Stores
31
34 K-Press Finished Stores
35
36 General Tool Grinding
39 Duplex Milling
42 Tool Making and Machine Repair
43 Flat Grinding
44 Milling Dept. Horizontal and Vertical Mills
45 Light Planing
46 Heavy Planing and Rail Mills
47
Main Factory Office

Fig. 13 Diagrammatic Plan of Second Floor Where Flat Work is Produced and Primary Assembling

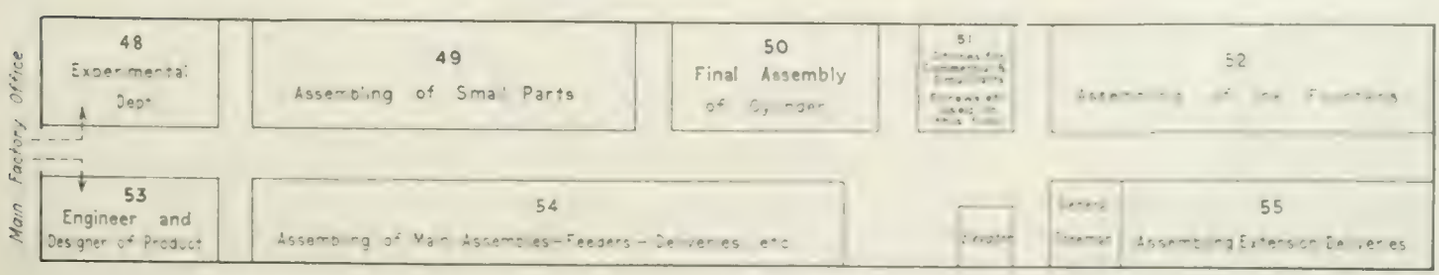


Fig. 14 Diagrammatic Plan of Third Floor Where Sub-Assemblies Are Made

termed Local Special Tools (3), a department in which are gathered two or three of the types of general tools necessary to complete the quantity of parts locally without moving them a considerable distance to a segregated group or department of such tools, and then back again to a point adjacent to the position from which moved. An example would be a small special

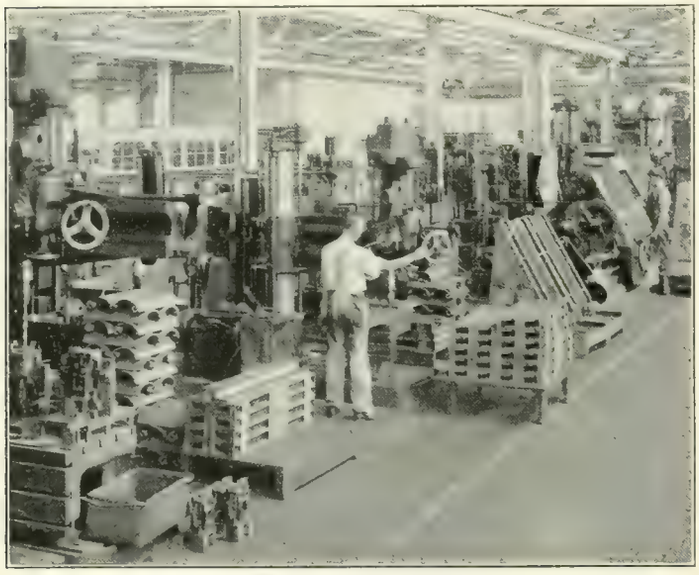

FIG. 15 RADIAL DRILLS AND SPECIAL TOOLS FOR FINISHING COLUMNS—FLAT WORK

stud with threads on both ends and a hole drilled diametrically through one threaded end for a cotter pin. The drilling and finishing or burring would be done at (3).

Adjacent at (4) is the Local Inspection for final inspection of work produced at (2) and (3), after which the finished product passes a short distance to the elevator and up one floor to the second or Assembly and Test level to Finished Stores, shown by Fig. 13.

It should be noticed that finished hand screw machine products from (6) flow in the reverse direction to (4), the same Local Inspection, and thence to Finished Stores as just described.

In like manner cut bar stock requiring turning (14) pass to (15), a Local Machine Center for special work, and thence to (16) for grinding, if required, or directly to the Local Inspection (18) which is again convenient to the elevator.

The paths of various castings shown by dash-dot-dash lines can be traced from (8) and (11) Rough Stores Castings in like manner. These also follow the same system, major work in proper sequence in segregated machine groups, thence to adjacent Local Special Machine groups, thence to Local Inspection, and finally, with one elevator handling, to Finished Stores which are placed adjacent to the particular assembly and Test Sections, as shown by Fig. 13.

Fig. 13 shows the second floor or railroad track level. This is where "flat work" is concentrated. Flat work includes planing and milling of pedestals or columns, planing tracks, beds, and shaping. Here also are the segregated drilling and milling departments, finished stores and main assembly and test departments.

On this floor raw or rough heavy material enters from the right, as indicated by the dash-dot-dash line. The small flat stock is delivered to this floor by the elevator, and the path of such parts is shown by the dash line. Completed material ready for Finished Stock from the first floor, comes up by elevator and moves as shown by the line of small black dots. These also show the path of finished parts from stores to the third floor, where various sub-assemblies of ink-fountains, feeders, etc., are made and then delivered to the main assembly sections or erection floor at (22), (23) and (24).

Trace now a heavy part, such as a base, or column, as it is termed. These are delivered from the foundry or from yard stock (47), to (41) or (46) for facing and other flat cuts. They pass to (40), a local special machine group, for drilling and some other simple intermediate operations, then to the erecting floor at (22), (23) or (24), depending on the type of press for which intended.

Other castings requiring flat work that have had round work done on them on the first floor, come up by elevator and follow the dash line and return through a Local Inspection at (38), thence to Finished Stores (27), (28), (29) and (34). To these storerooms are delivered parts used in erecting, which is

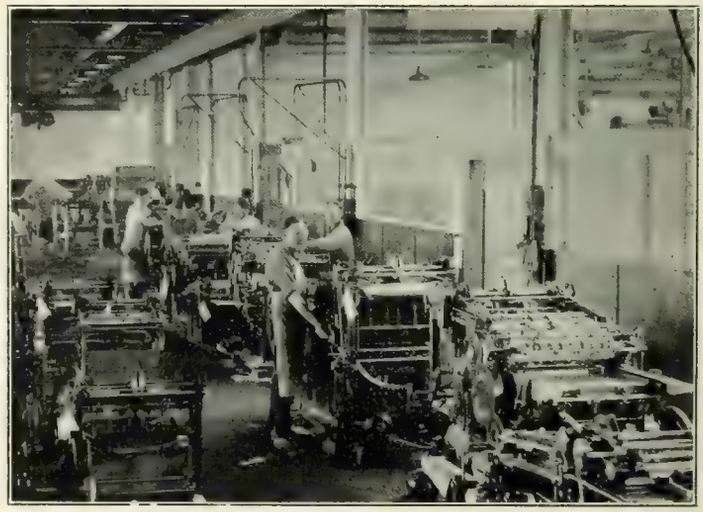

FIG. 16 FINAL TEST DEPARTMENT, SHOWING SWINGING PENDANT ELECTRIC TERMINALS

done adjacent to the storeroom on the south side, or window side, of the floor.

The third floor layout and operations, almost entirely group assembly, are shown by Fig. 14.

The division of the work into two general classes and the arrangement of the machines as here outlined is so practical and easily understood that there has been little or no confusion in getting it in operation. It has reduced our trucking of parts in process over 50 per cent, and has been very helpful to us in increasing production and reducing manufacturing costs.

# Novel Budgets Cut Indirect Expenses

## 10 to 50 Per Cent Reductions Secured

By U. L. HARMON

*Factory Comptroller, The Mason Tire and Rubber Company*

THE Mason Tire and Rubber Company has made great strides through the use of time and motion studies in reducing the manufacturing costs of its product. Methods and results were explained in the January issue of MANUFACTURING INDUSTRIES. In working out this plan, however, other elements of expense were brought to light, which had not been taken care of before. We then inaugurated a plan of budget control to cover these various elements. This paper explains in detail the methods used and the results accomplished.

In this plan we were not interested in budgets in the broader sense, but rather from the viewpoint of the manufacturing division, with the hope that they would be a means of reducing costs and also of constructive value in solving our problems. We were not in a position to install budgets covering sales, purchases, administrative and advertising expense, etc., and therefore our work covered only those items which came directly under plant or manufacturing control.

### NEED OF COST REDUCTION

In the former article[1] it was mentioned that the Mason Tire and Rubber Company found it necessary, due to economic conditions wholly beyond its control, to make radical reductions in the manufacturing cost of its product. We had four ways whereby this could be accomplished, namely:

1. Arbitrarily reducing the wages of our workmen.
2. Using a cheaper grade of material.
3. Reducing overhead and indirect expense.
4. Reducing sales cost.

The second and fourth were impossible as our product is highly competitive; lowering the standard would have done more harm than good and our sales cost was increasing due to strong competition. We had no thought of arbitrarily reducing the wages of our workmen, but did make great savings by the use of time and motion studies, as already explained. This reduced the unit cost of our product, increased the earnings of our workmen and gave a larger volume of production. Therefore, our next plan centered on the reduction of overhead and indirect expense through the use of budgets.

We found that our time and motion study work was accomplishing all and more than we had hoped for, and did not consider the direct labor expense in any of our budgets, except to estimate our payrolls at various periods, for we did not plan to use our budgets for the purpose of estimating our expenditures from the standpoint of knowing how much money we were spending for labor as a whole, material, etc. We started work on our budgets for the sole purpose of reducing the manufacturing cost of our product from the manufacturing standpoint. This thought will have to be carried in mind throughout the reading of this article, as in this way only will the reader get the full meaning of what our budget plan has meant to us. Our purpose, as stated, was to reduce those items of expense, which entered into the cost of our product from the factory point of view.

We now have budgets covering:

1. Indirect or non-productive labor expense.
2. Schedules.
3. Waste.
4. Blemish and repair work.
5. Miscellaneous supplies.
6. Maintenance.
7. Labor turnover.

We did not attempt to install all of these budgets at one time, but they were the outgrowth of continued efforts and were added as our experience increased.

Our first attempt was centered on our weakest point, that of indirect or non-productive labor. Knowing that our indirect labor was out of proportion to our direct labor, because of the changes we had made, we set about to bring it down somewhere near to what it should be. We also wanted to maintain the proportion of indirect to direct labor, approximately 25 per cent of the total labor cost.

### INDIRECT LABOR BUDGET

This first attempt to control our indirect labor expense by budget was simple and crude, but after working on it for over two years we still adhere somewhat to the same plan, not so much for estimates, but to have a selling point for our department heads. They feel that any attempt to reduce the day work force necessary to operate individual departments is an infringement on their rights. Therefore, we made a list of all help on an hourly rate, specifying what

[1] MANUFACTURING INDUSTRIES, January 1926, page 51

each man was doing in the department, how many hours he worked and his hourly rate. We practically determined from this list what help was actually necessary and what each department was carrying as excess. It had been the practice to carry additional men to act as buffers in case of absentees, so that the various departments could produce their share of production without difficulty or embarrassment to the department heads.

By the use of time studies we were able to estimate how much work the piecework operators could accomplish in a given time, and from these records determine how many men it would be necessary to have available to keep the pieceworkers busy all the time. Thus we found that an inspector could inspect the work of so many operators producing so many tires per hour and still do justice to the work; so many truckers could handle the necessary stock from one department to another for that many tires; and so many supply boys could supply that many men with the proper material, etc. As stated in the previous article we practically eliminated all "bottle necks" and had an even flow of material. Barring accidents to machinery, or other things beyond our control, we no longer had one department waiting on another for material or supplies.

## Schedule Budget

Having completed this tentative list we then took the average hourly rate for foremanship, inspection and general labor, multiplied it by the hours the department worked and used that amount for the departments estimate for the day. However, here was an obstacle, for we were operating on a blanket schedule with no predetermined amount of production per day. This condition we corrected by the Schedule Budget. One fact that this brought out was that we cannot, and I doubt if any company can, set a budget for indirect labor expense which will be applicable to all productions, for hourly rate help does not bear the same ratio to production that direct labor does. During this period we even went so far as to have the department heads report to the head of the budget plan the number of hourly rate men or day workers who were absent every day, whether they had to "borrow" a man from some other department to fill his place, and what the department from whom the man was borrowed did in his absence. Thus we were able to check more closely, from day to day, as to whether all the men on the payroll in every department were absolutely necessary. From carbon copies the department heads, who made the reports, could check back and see how many days of the week they worked short handed, and the days it was necessary to borrow men to fill vacancies. One can readily see how the department head would soon be in such a frame of mind that he would plan his work to make it unnecessary to carry this additional help and would eliminate it without being told to do so.

With the above data collected, and a predetermined daily schedule worked out, our first departmental budgets looked like the table below:

Calendar Department (2000 tires, 4000 tubes per day.)

| Description | Number of men | Hours | Hourly rate cents | Expense per day |
|---|---|---|---|---|
| Foreman | 1 | 9 | 75 | $6.75 |
| Inspector | 1 | 9 | 69 | 6.21 |
| Weighmaster | 1 | 9 | 60 | 5.40 |
| Truckers | 3 | 9 | 51 | 13.77 |
| Liner table men | 4 | 9 | 45 | 16.20 |
| | | | | $48.33 |

Tire Department (2000 tires per day.)

| | | | | |
|---|---|---|---|---|
| Foreman | 1 | 9 | 90 | $8.10 |
| Inspector | 6 | 9 | 75 | 40.05 |
| Truckers | 6 | 9 | 57 | 30.78 |
| Supply boys | 6 | 9 | 45 | 24.30 |
| | | | | $103.23 |

Each department head was given a list which covered his department. In no instance did it include, nor does it yet, any man who is on a salary basis, for if we keep our salary men on low production, it is because we have spent considerable time and money to develop them for their particular position, or they are too valuable to "let out" for a temporary lull in production. The plant must bear that overhead expense as part of the privilege of being in business. At first we assumed that in our plant we could vary our production a hundred tires before the departmental indirect labor would have to be changed, so we set up lists for each production, from 1000 to 3500 tires per day, in scales of hundreds of tires. From the above the reader will see how very simple and crude our budgets were at first. However, it answered our purpose and gave us a group of figures with which to work.

## Development of the Plan

We carried out this plan for four months and then had enough data to start work in a more intelligent manner. We still use the plan of itemizing the number of day workers necessary to operate each department, but there are other items that enter into the operating expense of a department which can hardly be figured on an hourly basis, such as handling material, the working of waste, labor which is idle because of machine breakdown, a beginner who is learning, and the transfer of a skilled piece worker from one job to another on which he is not skilled, with pay as day work or hourly rate for the time being, etc. With the figures we collected by the foregoing method we were able to set up an estimate for the averages of these miscellaneous expenses, and add this to our daily expense list. Now we have a budget on indirect labor by which we can forecast each department expense for practically any production the sales department wishes the factory to produce, changing for every fluctuation of 500 tires, instead of 100 tires as before.

Incidentally we now are able to get a blanket schedule for two or three months in advance, and

arrange a daily production schedule from it. This helps materially.

Assuming that our production for the next three months is to be 2500 tires and 5000 tubes per day, we again make out our list for the number of day workers each department needs. We are able to come very close, within a few hours of the actual working time for each class of work, and get the actual dollars and cents each department needs for hourly rate men, barring unforeseen occurences that might and do arise. To this we add a certain percentage for contingencies, arrived at from the data of previous experiences. We then take the total amount for foremanship for the separate departments and divide it by the number of tires or tubes on the schedule; and so on with the amounts for inspection, general labor and contingencies.

### Form for Foreman's Budget

In other words the budgets now given to the foremen are shown in Table 1.

TABLE 1 FORM FOR FOREMAN'S BUDGET

| [illegible] per tire | Inspection per tire | General labor [illegible] | Contingencies [illegible] | Total cost per tire | Total cost per day |
|---|---|---|---|---|---|
| $0.00291 | $0.01123 | $0.01468 | $0.00288 | $0.03170 | $79 25 |

All budgets are based on the quantity of units produced in each department in terms of completed tires or tubes, for there are times when our production fluctuates very much, and some departments must increase or decrease their stock inventory to such an extent that, if we used the number of tires or tubes actually completed that day, it would be unfair to some of the departments. We carry a progressive record of each department's expense, as shown in Table 2, which is checked daily. Whenever any department has expenditures exceeding its budget by more than five per cent, it is taken up with the department head so that he can eliminate the additional charge if possible.

TABLE 2 RECORD OF DEPARTMENTAL EXPENSE

| Date | Tires built | TIRE DEPARTMENT [illegible] | | | | STOCK PREPARATION DEPARTMENT [illegible] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | [illegible] | | [illegible] | | [illegible] | | [illegible] | |
| | | Per day | Progressive | Per day | Progressive | Per day | Progressive | Per day | Progressive |
| October 1 | 2505 | $37 57 | $37 57 | $35 17 | $35.17 | $25.05 | $25.05 | $26 02 | $26 02 |
| October 2 | 2498 | 37 88 | 75 45 | 38 24 | 73 41 | [illegible] | 50 30 | [illegible] | 53 07 |
| October 3 | 2540 | 37 95 | 113 40 | 37 60 | 111.01 | 25.30 | [illegible] | 25 75 | 78 82 |
| October 4 | 2505 | 37 57 | 150 97 | 38 00 | 149 01 | [illegible] | 100 65 | [illegible] | 104 06 |
| October 5 | 2510 | 37 65 | 188 62 | 35 12 | 184 13 | 25 10 | [illegible] | [illegible] | 127 06 |
| October 6 | 2511 | 37 67 | 226 29 | 36 15 | 220 28 | 25 11 | 150 86 | 23 12 | [illegible] |

When we first started the use of time and motion studies in our plant we felt that we had accomplished all that was possible toward reducing our indirect labor expense. However, since working on this budget plan, we have found we had barely touched this item of expense. Within six months we were able to reduce it approximately 20 per cent and have made additional reductions practically every month, until it is now only 60 per cent of what it was two years ago. This has been accomplished without reducing wages.

In working out this plan we soon found that several factors tended to keep up this expense. The largest was waste of material in process. The inspection, handling, salvaging and scrapping of waste caused a great difference in the daily expense of some of our departments, to say nothing of the loss of time on the part of the piece workers, who, in many cases, had to work it up in the normal course of their work. Thus a budget plan for the reduction and elimination of waste material in process was set up.

### Budget for Waste

In the tire and tube business, as in practically all other manufacturing, there is some waste which cannot be avoided and must be allowed for in all specifications. There were certain standards for this unavoidable waste, such as "Roll ends" and "Selvage" in our Calender Department, "Angle Ends" in one Stock Preparation Department, "Builders Trim" in our Tire Building Department, etc. But we found that even some of that could be reduced. All defective stock, poor workmanship, etc., was added to our unavoidable waste and our budgets figured on a percentage basis for all stocks handled in each department. The amount of waste of each department is figured daily, also, and the departments are notified in case of excess, as with indirect expense.

This reduction of waste brought about a reduction of our "seconds" and repairs, so a budget for this followed as a natural sequence.

We then went into the item of Miscellaneous Supplies, such as gasoline, benzol, soapstone, etc., used in the various departments and set a budget for them.

### Budget for Maintenance

Another factor which was soon brought to our attention was the maintenance of our equipment. At one time we were adding an appreciable amount to the cost of our product, due to excessive maintenance. By adding this to our series of budgets we have brought it down to a minimum. By having regular inspection of our machines and equipment, and making whatever minor adjustments are necessary we prevent breakdowns and loss of time.

With improvements in our methods through the above budgets, we found that the efficiency of our working force, and the quality of our product, depended to a great extent on the labor turnover in the plant. By placing a budget on this item in our plant, and by giving each

individual a fair and square deal in all of our connections with him, we have reduced our turnover from approximately 20 per cent to 5 per cent per month.

Thus we are operating our plant with a seven-phase budget control. Each budget is separate and distinct, yet each one has a decided bearing on the other, insofar as expense is concerned, and being so interrelated that when some difficulty arises in one department it is affected by the other. In other words, if the amount of waste increases it not only slows up production, affecting our schedule, not only means we are throwing away valuable material, but also means we must have additional men to salvage any that can be saved. This extra work is indirect labor and is chargeable to that item of expense in the department concerned. Other items are affected in some way which is reflected throughout the whole organization.

Our budgets are given out to the department heads in the following form and a master copy kept by budget department and plant superintendent:

1. Schedule
   2,500 tires per day 50,000 per month.
   5,000 tubes per day 105,000 per month.

2. Indirect labor

| Foreman-ship per tire | Inspection per tire | General labor per tire | Contingencies per tire | Total cost per tire | Departmental cost per day |
|---|---|---|---|---|---|
| $0.00291 | $0.01123 | $0.01468 | $0.00288 | $0.03172 | $79.30 |

3. Waste

| | | |
|---|---|---|
| Roll ends | 1.5% | of Stock Delivered |
| Selvage | 1.15% | " " " |
| Defective fabric stocks | 2.6% | " " " |
| Defective gum stocks | 2.8% | " " " |

4. Blemish and repairs
   Blemish 0.5%
   Repairs 1.5%

5. Miscellaneous supplies

| Gasoline | Gallons per tire | Cost per tire | Cost per day |
|---|---|---|---|
| | 0.015 | $0.0024 | $6.00 |

6. Maintenance

| Cost per tire | Total cost per day |
|---|---|
| $0.00325 | $8.13 |

7. Labor turnover
   Average payroll (125 Men) 8% per month.

At the end of each month the department heads are given a comparative report of what they have accomplished.

1. Schedule

| Budget per month | Actual per month |
|---|---|
| 50,000 tires | 49,570 tires |
| 105,000 tubes | 106,200 tubes |

2. Indirect labor

| Budget per tire—tube | Budget per month | Actual per tire—tube | Actual per month | Loss per month | Saved per month |
|---|---|---|---|---|---|
| $0.03172 | $1572.36 | $0.03269 | $1620.70 | $47.34 | |

3. Waste

| Pounds delivered | Scrap budget | | Pounds scrap allowed | Pounds scrap actual | Pounds scrap lost | Pounds scrap saved |
|---|---|---|---|---|---|---|
| 250,000 of fabric | (Roll ends) | 1.5% | 3750 | 3540 | | 210 |
| | (Selvage) | 1.15% | 2875 | 2360 | | 515 |
| | (Defective) | 2.6% | 6500 | 4500 | | 2000 |
| 100,000 of gum stock | (Defective) | 2.8% | 2800 | 2500 | | 300 |

4. Blemish

| Budget per month: Tires blemished | Per cent | Actual per month: Tires blemished | Per cent | Loss per month | Saved per month |
|---|---|---|---|---|---|
| 247 tires | 0.5 | 198 tires | 0.4 | | 49 tires |

Repairs

| Budget per month: Tires repaired | Per cent | Actual per month: Tires repaired | Per cent | Loss per month | Saved per month |
|---|---|---|---|---|---|
| 743 tires | 1.5 | 644 tires | 1.3 | | 99 tires |

5. Supplies

| Budget per tire-tube | Budget per month | Actual per tire-tube | Gasoline Actual per month | Loss per month | Saved per month |
|---|---|---|---|---|---|
| .015 gallons | 743 gallons | .0145 gallons | 720 gallons | | 23 gallons |
| $ .0024 | $118.97 | $ .0023 | $114.01 | | $4.96 |

6. Maintenance

| Budget per tire | Budget per month | Actual per tire | Actual per month | Loss per month | Saved per month |
|---|---|---|---|---|---|
| $ .0078 | $386.64 | $ .0071 | $352.70 | | $33.94 |

7. Labor turnover

| 10 men | 8% | 6 men | 4% | | 4 men |
|---|---|---|---|---|---|

One feature in connection with this budget plan which has helped to make it a success, has been a system of bonuses paid to each department head for making his budgets. This acts as an added incentive. The department heads not only have pride in the fact that they are operating their departments efficiently, but their incomes are increased accordingly. We pay this bonus once a month on each separate budget, based on a percentage of the monthly income as follows:

| | *Per Cent* |
|---|---|
| 1. For making required schedule | 2 |
| 2. For making indirect labor expense | 3 |
| 3. For making waste budget | 2 |
| 4. For making blemish and repair budget | 2 |
| 5. For making supply budget | 2 |
| 6. For making maintenance expense | 2 |
| 7. For making labor turnover budget | 2 |

By the use of the above budgets we have made radical reductions in operating costs as follows:

| | *Reduction Per Cent* |
|---|---|
| 1. Indirect labor expense | 40 |
| 2. Waste | 25 |
| 3. Blemish | 30 |
| Repairs | 50 |
| 4. Miscellaneous supplies | 10 |
| 5. Maintenance | 25 |
| 6. Labor turnover | 15 |

From these results it can be seen that we have accomplished our purpose in reducing manufacturing overhead and indirect expense.

# Cost of a Short-Sighted Power Policy

## $13,000 a Year Saving Passed Up by Neglect of Engine Room Changes

By ANDREW F. SHEEHAN

*Mechanical Engineer*

LACK of interest on the part of the management is very often the real cause of excessive power costs in industrial plants. Of course, in many industries the power cost is small in relation to total production cost and the power plant is not considered worth any great amount of managerial attention. But in other industries, notably the pulp and paper industry, the power cost is often as high as 40 per cent of the manufacturing cost.

### The Manager's Responsibility for Power

It is not necessary that the manager interest himself in the theory of power generation or the routine of the power plant, but only in the cost figures. Any time spent in the latter direction will prove well worth while.

I was at one time chief engineer of a paper mill whose output was 20 tons daily and the coal consumption around $1\frac{1}{4}$ tons of coal per ton of paper produced. I considered this figure rather high and set about reducing it as far as possible without interfering with the regular schedule. By the substitution of exhaust steam in place of live steam on the largest paper machine, the coal consumption was reduced two tons per day and the cost of making this change was only $100 for piping and labor. This meant a reduction in operating cost of about $400 per month and no overhead charges were involved which might reduce the net saving.

The manager was favorably impressed with the improved showing in this department and told me that he had been considering the plan of installing a new boiler of the water-tube type which would save coal by replacing our four boilers with the fire-tube type. I asked that this plan be postponed long enough for me to make a complete survey of conditions, as it involved the expenditure of about $21,500 for the boiler, cost of erection and enlargement of the boiler house.

### Methods and Equipment in Use

We had at the time four 150 hp. boilers, and one 500 hp. unit was to replace these. A reduction of 10 per cent of our coal bill was possible by this method and the manager was enthusiastic over the plan, as our old boilers were 20 years old and were wasteful of fuel. But in the engine room I found opportunities for reducing costs that were of greater magnitude than the 10 per cent saving to be made in the boiler room.

Our main engine was a single cylinder Corliss and was operated condensing; the coal required for its operation was about $2\frac{1}{2}$ lb. per hp. hr. The engine was carrying an overload and consequently the water rate was high, around 20 lb. per hp. hr. The evaporation rate was 8 lb. of water per lb. of coal, which gave the figure of $2\frac{1}{2}$ lb. of coal per hp. hr. Our load being 400 hp., the engine used 1000 lb. of coal per hr., or 12 tons per day of 24 hr.

In the machine room, the two paper machines were driven by individual engines of the slide valve type, taking steam at 125 lb. pressure and exhausting at 10 lb. back pressure into the driers. These two engines developed a total of 110 hp. and the total steam flow to the driers was 6000 lb. per hr., including the live steam which was used to help out the engine exhaust. I allocated the amounts of steam shown in Table 1 to each of the various units in the mill.

TABLE 1. ALLOCATION OF STEAM TO UNITS

| Unit | Lb. Steam per Hr. |
|---|---|
| Main engine | 8,000 |
| Engines on paper machine.. | 4,000 |
| Live steam for driers | 1,000 |
| Condenser and feed pump | 1,333 |
| Total | 15,333 |

* Water estimated to be 15 lb. per hp.

The total steam required was 15,333 lb. per hr., after the reduction of two tons of coal daily had been made. Water evaporated per lb. of coal was 8 lb., and coal consumption 23 tons per day. This mill operated 300 days a year and as the coal cost $7 per short ton the annual fuel bill was $23 \times 300 \times 7 = \$48,300$. With a saving of 10 per cent possible by the installation of the new boiler the maximum cost reduction along that line was $4830 per year. To make this saving, the company would have to invest $21,500 and, allowing fixed charges of $12\frac{1}{2}$ per cent, $2687 must be deducted from the fuel saving, which brings the net saving down to $2143 per year. The net return on the investment that the management intended to make figured only 10 per cent of the capital, and so I submitted the following plan which would save more fuel without so large an initial outlay.

In any industrial plant requiring process steam, the power from engines that exhaust into driers, or

similar processes, is obtained at practically no fuel cost. Over 90 per cent of the heat in the steam is still in the exhaust as it leaves the engine, and if used in process this heat is reclaimed, while in the case of a condensing engine this latent heat is lost. The plan of exhausting from the machine room engines to the driers was sound engineering as far as it went, but the principle was not carried out to the fullest extent with the equipment we had. Also, our Corliss engine, using 52 per cent of our total coal consumption, wasted 90 per cent or more of the heat supplied to it, as it exhausted into a condenser. To use all of this exhaust in the manufacturing process would have been impossible, as no demand for so much steam existed and the engine would not be able to carry the load if operated against back pressure.

Now as to the savings my plan would effect and the cost of putting it into practice: The drying process required 6000 lb. of steam per hr. under any system of power supply, so this was the starting point. The paper machines were to be motor-driven and the current was to be generated by means of the Corliss engine, which would operate at a reduced load and exhaust 6000 lb. of steam per hr. to the driers, the load being balanced so that there would be no excess exhaust from this engine except that required for feed water heating. The water rate of the Corliss engine would be about 28 lb. per hp. hr. under these conditions and the load carried would be $\frac{6000}{28} = 214$ hp., practically double the amount of power previously derived from the process steam. At this output the Corliss engine would be operating at its economical load.

### Supplying Remaining Power Needs

Since the total power requirements for the mill were 400 hp. on the main shaft and 110 hp. in the machine room, there was a balance of $510 - 214 = 296$ hp. to be supplied in some way. If a condensing unaflow engine were installed, this power could be generated at a water rate of 13 lb. per hp. hr., thus calling for $296 \times 13 = 3848$ lb. of steam per hr. The previously installed feed pumps and condenser pump, using 1333 lb. per hr. at a rate of 60 lb. per hp., showed a power input of $\frac{1333}{60}$ 22 hp. Replacing these pumps with motor-driven units whose power source was the unaflow engine, would give us the 22 hp. for only $22 \times 13 = 286$ lb. of steam per hr., or a saving of 80 per cent in auxiliary power cost.

The total steam consumption of the mill would be $6000 \text{ lb.} + 3848 + 286 = 10{,}134$ lb., as compared with 15,333 lb. per hr.; a reduction of 5199 lb. per hr., or one-third the total steam consumption. This meant that one-third the coal bill would be saved and this saving would amount to $\frac{\$48{,}300}{3} = \$16{,}100$ annually.

The cost of a 300 hp. unaflow engine would be around $14,000 including cost of foundation. But it would not be necessary to invest this amount of money at the start, as one well-known engine builder guarantees to install his engines with a definite understanding that they will reduce costs. The engines built by him are installed on a very small cash payment, the balance of the purchase price not being paid till the engines effect the guaranteed saving. For instance, where such a large saving as $16,000 annually is possible, the cash payment is not over $1000 and I can name one case where the initial payment was only one dollar, a $25,000 engine being installed and saving $26,000 a year in coal costs.

### Amount of Investment Involved

Thus the engine would pay for itself in less than a year, the monthly saving being turned over to the engine builder till the engine was paid for. Motors could be installed on the paper machines at a cost of $2500 and motor-driven pumps could be installed for $1500. The total initial investment would be only the first payment of $1000 on the engine, plus $2500 for motors and $1500 for electric pumps, making necessary an outlay of $5000 which would effect a saving each year of $16,100 in coal costs.

At the end of the first year of operation under this plan the net saving would be the coal saving minus 12½ per cent fixed charges on the $4000 worth of electric equipment, or $15,600, and this saving in one year alone would pay off the engine cost. After the first year, the saving of $15,600 annually would return three times the amount of the original investment every year, amounting to a dividend of 312 per cent on the invested capital. The engine cost could not be added to the investment, as only $1000 of the firm's money would be spent for it, the rest being paid for by money that would have to be spent for coal if the engine were not installed.

But when these figures were placed before the manager, he told me that the contract for the new boiler had already been signed and that no more money would be spent on the power plant for some years to come. In vain I pointed out that the money invested in the boiler was earning only 10 per cent and that my plan would show three times as great a fuel saving at a capital outlay only one-fourth as much, compared with his method. Furthermore, had my plan been carried out, he could have had the new boiler also by waiting a year and a half, as the savings in this period would be over $22,000, enough for a new boiler without drawing on the firm's capital.

But because the manager did not consider power plant problems worthy of close study, he fell into an error which will cost his firm a big sum of money in the next few years. Had the foregoing plan been adopted and the savings each year been applied to further improvements, such as underfeed stokers for the boiler room the second year, replacing the old Corliss engine with another unaflow unit the third year, and so on, the cost-cutting process could have continued to a point where the plant would have been a model of efficiency.

# Peerless Portland Cement Pioneers in Plant Design and Layout

By JOHN GILLESPIE

*Secretary and Treasurer, Peerless Portland Cement Company*

THE Peerless Portland Cement Company began the manufacture of cement at Union City, Michigan in 1897. By 1923 the demand for the product had increased to the point where greatly enlarged facilities were necessary. The problem of plant location was carefully studied to determine whether it would be a better business policy to enlarge the existing plant or build another one at a new location.

The latter course was decided upon and Detroit was selected as the site, for the following reasons:

1. A heavy local demand for cement existed in the region for a radius of at least 50 miles from this center.
2. Direct transportation of limestone, clay and coal was possible by water and by rail.
3. Direct rail and water shipments could be made.
4. Ample labor was available.
5. Power, water supply, street cars and busses, and other service facilities were in existence.

Three factors which made a city location undesirable were the high cost of land, higher taxes, and the necessity for installing equipment to prevent the dust from spreading over the community. But the prospect of large-scale operations and quick shipments by motor trucks, and the direct water and rail facilities which would reduce haulage and handling charges, far outweighed the few disadvantages of a city site. Moreover, by sacrificing a few of the advantages of straight-line production a plant layout was developed which economized on land area and therefore saved in initial cost and in taxes. Dust elimination meant a saving in product and improved working conditions, and hence the expenditure of thousands of dollars for the purpose might, in the end, prove to be a real economy.

The weight of evidence was decidedly in favor of a Detroit location. Accordingly, a tract of land on the Rover Rouge, 4½ miles from the center of the city, and formerly part of a lumber yard, was purchased and a complete layout and designs for all buildings and storage yards were carefully worked up for a 4500 barrel per day plant.

Fig. 1 shows a general view of the plant, and Fig. 2 gives the layout as finally adopted.

Trade journals have already published well-written descriptions of the plant as a cement manufacturing industry. Details of such operations would be out of place in the present article, which is planned for readers who are interested in factors of location, and in the development of plant layout and building construction and equipment to show how they make or mar the success of management. Hence, the outline following will point out only the method of planning the arrangement of buildings and equipment to gain the utmost all-round economy, cut down the manual handling of materials, maintain full control of production and shipping, and co-ordinate all departments into

FIG. 1 STORAGE SILOS PACKING HOUSE, LIMESTONE STORAGE YARD RAW MILL AND STORAGE TANKS AND BAG STORAGE

a smoothly and successfully operating cement plant.

Raw materials used in cement manufacture consist of limestone, clay, gypsum and water. Coal is used as a heating medium in the kilns to burn the clinker.

Limestone for the Peerless plant is obtained at Calcite, Michigan, and arrives at the plant in 10,000-ton, self-unloading lake steamers. Within five hours a steamer can discharge its entire cargo into hoppers feeding a 610-ft. long belt conveyor system distributing the stone to the storage yards. There are two such yards and between them the conveyor system runs. An overhead traveling crane serves each yard, and the total storage capacity is 150,000 tons, enough to carry operations through the winter season when receipt of material is temporarily cut off. These cranes also feed the hoppers discharging limestone into the raw mill. See Fig. 3.

Clay is received on railroad cars from the company's pits near Wayne, 20 miles away, and is unloaded inside of the clay storage building by an overhead traveling crane. A storage capacity of 20,000 tons is provided. This crane also feeds the clay into mills where water and caustic are mixed with it. The caustic is a by-product from the neighboring plant of the Solvay Process Company. It analyzes to 96 per cent calcium carbonate and is pumped as a liquid, 65 per cent water, through a 5-in. pipe line from the Solvay works at the rate of 250 to 400 net tons of material per day. Fig. 4 shows a view of the clay storage building and a corner of the caustic tank.

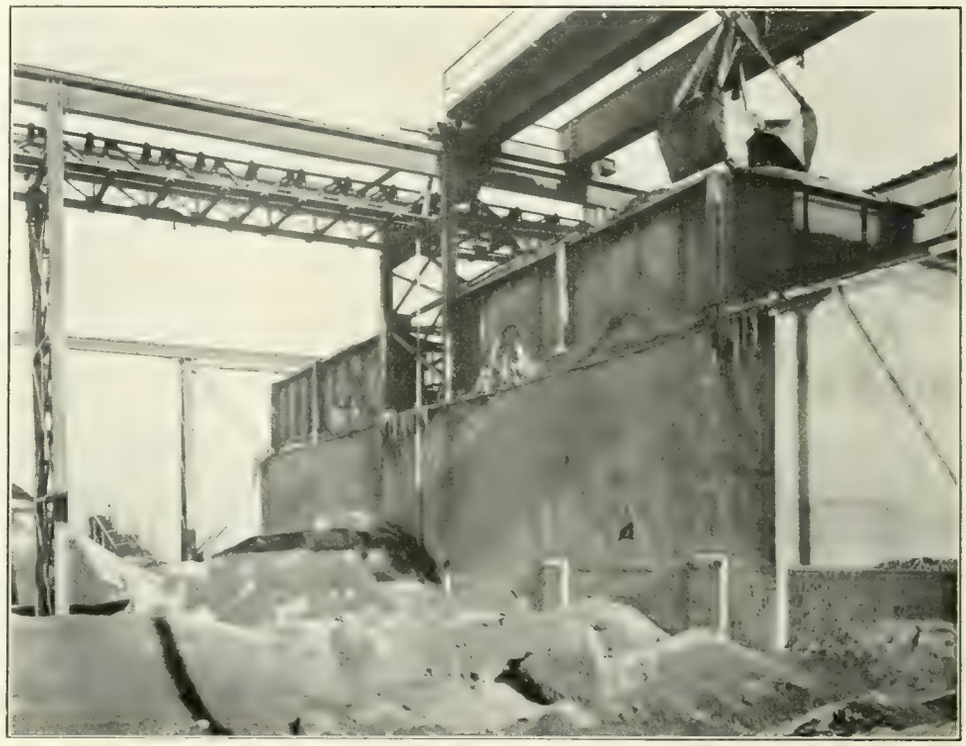

FIG. 3 CRANE FEEDING LIMESTONE INTO RAW MILL HOPPER

Small conveyor visible in lower left hand corner is discharge outlet of coal carrying system.

The mixed clay and caustic are pumped over to the raw mill, mixed and ground with crushed limestone, and run into the slurry and correction tanks. From thence they are pumped to the kiln room to be burned.

Gypsum comes in box cars from around Grand Rapids, Michigan, and is unloaded into a 3000-ton capacity storage building. An overhead traveling crane delivers it to a hopper in the finish grinding department.

Coal can be received either by rail or water, and is fed into a hopper and crusher at the river end of the coal storage yard. See Fig. 2. One railroad siding is reserved exclusively for coal, which is dumped into a track hopper and travels through an underground conveyor running beneath the bag house and limestone storage yards, and rising to the surface at the hopper and crusher above mentioned. If received by boat, a crawler-tread locomotive crane is called into service and transfers the coal into the crusher hopper. From thence it goes to a storage yard of 15,000 tons capacity.

An overhead traveling crane serves the coal storage and also the cement clinker storage, the latter of 100,000 barrels capacity.

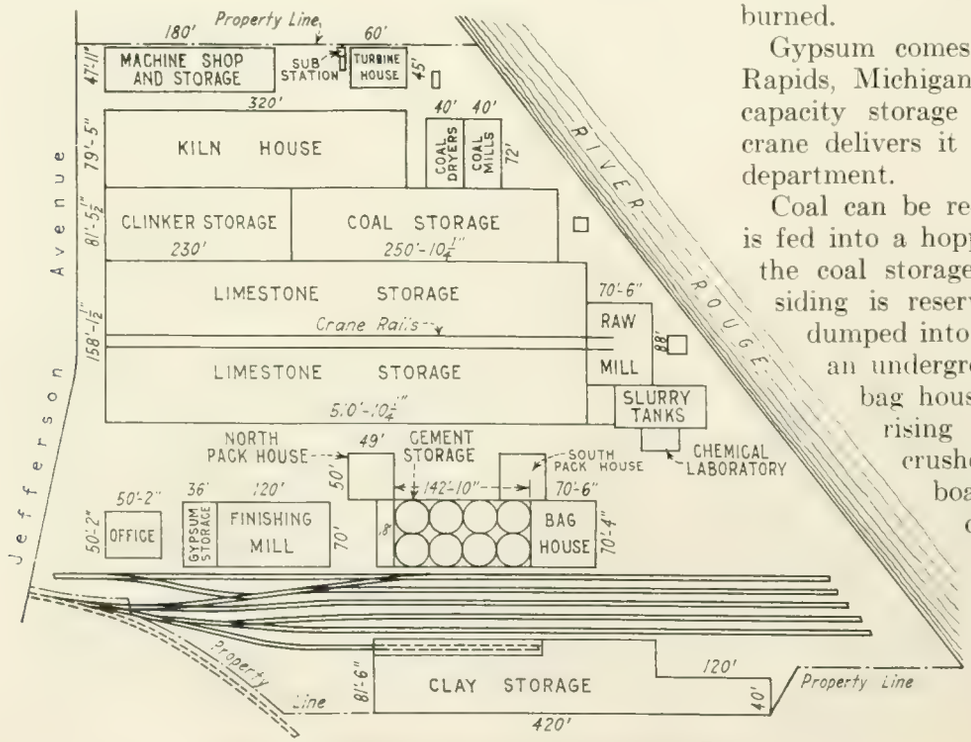


FIG. 2 GENERAL LAYOUT OF THE PEERLESS PLANT

FIG. 4 INTERIOR OF CLAY AND CAUSTIC MIXING BUILDING

The fuel is supplied to hoppers discharging it into the coal dryers after which it is pulverized and finally blown into the kilns.

The clinker produced in the kilns is discharged at the front end of the building into a pan conveyor which carries it to the storage and cooling yards. Here it serves to preheat air drawn into the kilns to support combustion. As the winter's storage of limestone is consumed, the limestone yards are also used for clinker storage, thus economizing room. An underground pan conveyor, fed by hoppers in the floors of the storage yards, carries the clinker to the finishing mill, where it is weighed, mixed with gypsum, carried by a bucket conveyor to hoppers discharging into rotary grinding drums, and then delivered by means of elevators and overhead screw conveyor systems to the cement storage silos. Fig. 5 shows a part of the finishing mill and the silos.

From the bottoms of the silos the the cement is carried in reversible screw conveyors to either one end of the building or the other, as required, is raised in a bucket elevator, sieved, and carried by a screw conveyor to bag-filling machines in the pack houses.

There are three of these filling machines in the north pack house and four in the south pack house. See Fig. 6. Each can fill about 16 bags per minute. The bags are closed at the top and are filled through self-closing check valves in one bottom corner. As they are discharged from the machine they slide down chutes onto traveling belts which deliver them to other belts, swiveled at the receiving end and lowered at the other end to any positions convenient for loading onto trucks in the driveway below. See Fig. 7. When not in use these latter belt conveyors are raised by motor and cable attachment until they are horizontal.

In the south pack house the belts leading from the filling machines can be reversed to discharge bags to a cross conveyor system leading directly to the freight car siding for rail shipments. At its discharge end the conveyor empties onto a second section on tracks so that it can be run out over the first railroad siding to the second, if cars located there are to be loaded. Eventually, a conveyor system will be run down to the dock to provide for shipments by water.

Packing machines have a capacity of 160 barrels per hr., each, and thus over 1000 barrels per hr., can be loaded and shipped by motor truck.

As the bulk of shipments go out by truck a paved driveway has been provided from the front gate down past the pack houses, around a turn and back up beneath the houses. Four trucks can be loaded at one time beneath the south pack house and three beneath the north pack house. Traffic is regulated to avoid confusion and congestion. Loaded trucks go out a second driveway paralleling the incoming driveway.

The types of construction adopted varied with the individual uses of the various structures. Most of the buildings are of steel frame construction, with metal lath and gunite cement walls. The clay storage, gypsum storage and finishing mill have troweled cement walls. The storage silos, bag house and pack houses are of reinforced concrete. Red cement tile roofs are used throughout. Many of the buildings have monitors while others have steel A-frames supporting the roof. Flashings are all of copper. Gutters and leaders are omitted in cement plants because the

FIG. 5 SHIPPING DRIVEWAYS, SILOS AND FINISHING MILL

dust hardens in them and they cannot be kept clear.

The same trouble occurs with drains and sewers. Sanitary sewers are, of course, of concrete pipe but drains leading to storm sewers are all of surface type The sewers themselves are extra large to prevent clogging.

All of the large buildings are supported on piles driven down 75 or 80 ft. to bed rock. The dock, 863 ft. long, likewise is on piling and is built with heavy concrete construction tied in strongly to the back soil. A 5-ft. sea wall extends along the water side.

For cleanliness, appearance, and convenience of traffic, cement driveways have been installed or planned for all the main arteries of travel. A concrete and wire-mesh fence is also contemplated for the three land fronts of the property.

Concrete and steel construction is fire-resisting and to carry protection into effect completely, parts of the building such as windows, stairs, partitions, platforms, etc., are likewise made of non-combustible materials. Window sashes and stairs are steel. Partitions are of cement on metal lath. Platforms and similar interior constructions are of reinforced concrete. It was not necessary to install sprinklers, but hand extinguishers have been placed at all points where small fires might occur due to motors burning out, and similar accidents. Plain transparent glass is used in the windows because the buildings are too far apart to require the extra fire protection given by wire glass.

A fire pump in the power house, hose lines, and convenient access to city alarm boxes further add to the protection of the plant.

Exterior doors are of wood, some with upper panels of glass to gain the advantage of light. Entrances for material are located and made of a size to suit individual needs. Smaller entrances for employees are likewise of wood and glass. In the bag house, where freight car service is provided for the receipt of bags and the shipment of cement by rail, rolling steel doors are installed because of the small space they occupy and the fire protection they give. In this building, also, there is an electric elevator and the enclosure is equipped with corrugated steel safety doors opening horizontally at the middle.

Interior doors are few in number because most of the departments occupy whole buildings without partitions. Where such doors are used they are of wood and glass construction.

Natural ventilation is employed throughout. Monitors and side walls are fitted with ventilating sections which allow comfortable conditions to be maintained indoors at all seasons of the year. At the bag-cleaning and cement-packing machines dust-collecting systems are installed, carrying cement dust to separators on the roof. From this point the reclaimed product is piped back to the pack house.

Interior walls are finished similar to exterior—gunite or smooth troweled cement in most cases, and reinforced concrete in the case of the cement storage and packing buildings. The walls are unpainted.

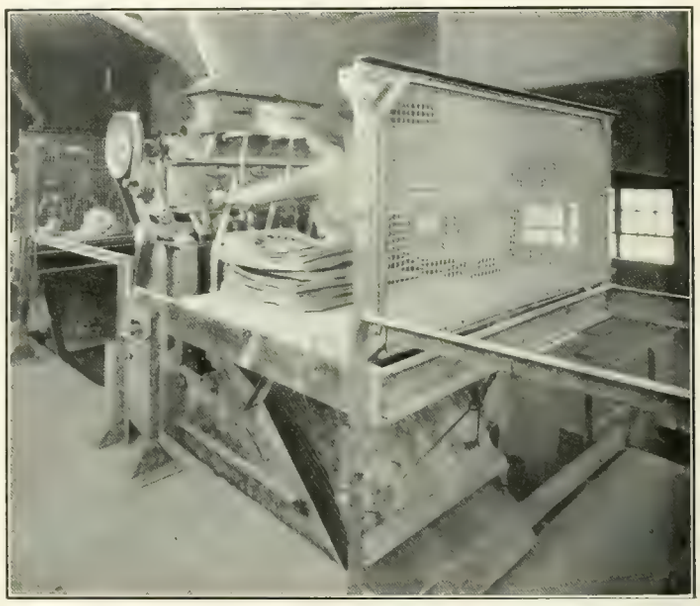

FIG. 6 BAG FILLING AND SIMILAR OPERATIONS ARE EXCELLENTLY LIGHTED

Floors are of reinforced concrete throughout finished with cement to provide a hard surface. Ceilings in multi-story buildings are the lower sides of concrete floors, and in single story buildings are formed by the under side of the roof tiles on steel frame work.

Direct lighting is employed throughout from 110 volt circuits. Lamps of 50 to 100 watts are employed with metal reflectors, spaced according to local needs.

FIG. 7 LOADING TRUCKS BY CONVEYORS LEADING DOWN FROM BAG FILLING MACHINES

Power for the plant is obtained from two sources. A 500-kw. sub-station is located in the yard to bring in outside current to supplement that produced at the plant. In addition, a power house has been installed to utilize steam produced by the waste heat from the cement kilns. Steam generating equipment is located in the kiln house. The exhaust gases from the kilns are drawn off first over superheaters, then through

waste heat boilers, next over economizers and finally through scrubbers to eliminate dust, after which they pass out through steel stacks. Waste scrubbing water is run into the river. Draft fans and by-pass flues complete the installation.

Three such systems of equipment are installed, one connected to each of the three kilns, to provide unit operation. Steam is generated at 225 lb. pressure and 100 deg. superheat and is delivered to the adjacent power house. An auxiliary boiler, running on pul-

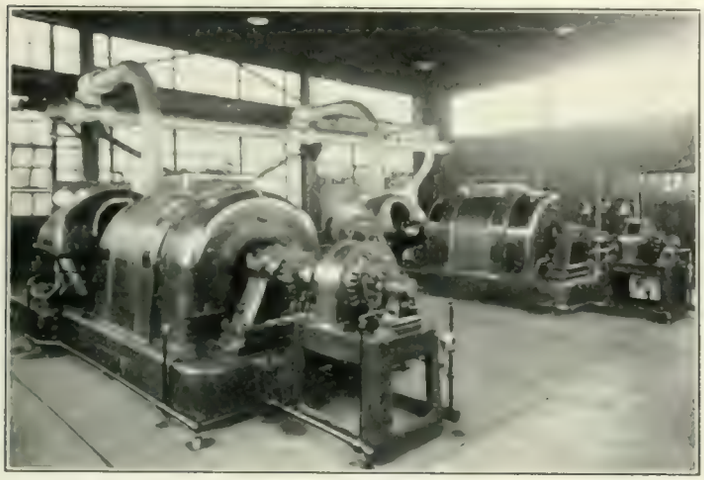

FIG. 8 TURBO-GENERATORS OPERATING ON STEAM MADE BY MEANS OF WASTE HEAT

verized coal, is located at the end of the kiln house to handle steam requirements in excess of the waste heat equipment capacity.

Two 3000-kw. turbo-generators with direct connected exciters, a 150-kw. motor generator set and a 150-kw. steam-turbine-driven D. C. generator, two surface condensers, circulating, vacuum and condensate pumps, a complete switchboard and oil switching equipment, and pumps for the heating system, constitute the power house installation. See Fig. 8.

Both generated and purchased power are used at several voltages—2200, 440, 250 and 110. Heat balance is maintained in power service by having part of the auxiliary equipment steam-driven and part electric-driven.

Steam heat is supplied to most buildings except the kiln house and finish mill, which are self-heating, the north pack house, which is not used in winter, and, the clay storage building in which few men are employed and salamanders serve the purpose. All heated buildings, except the office, which has a separate steam system, are connected to a central system operated at 10 lb., through a reducing valve in the boiler room.

Handling methods for coal and the various raw materials have already been outlined. Very extensive use is made of conveyor systems and, as a result, plant operation has been reduced to a steady smooth running, reliable procedure at all times.

Railroad track layout fits directly into the handling methods by the definite assignment of certain tracks for certain purposes only. Thus, of six tracks, one is for coal, one for gypsum, one for clay, one for storing and two for shipment of cement. A spur runs into the clay storage building. Trolley freight service connections are also provided. A gasoline locomotive shifts railroad cars in the yard.

Piping and all electric power lines are underground, the latter lead covered, waterproofed, and in fiber conduit laid in concrete. Interior wiring is carried in metal conduit.

The plant water supply for drinking, sanitation, and processing is obtained from the city mains. River water serves for condensing and cooling purposes.

Toilets and washrooms of modern type are installed in each building. Drinking fountains are located at convenient points. First aid equipment is provided to take care of all minor injuries and illnesses, and doctors and city hospitals are available should any serious cases need treatment.

The power house and kiln room operate on three 8-hr. shifts per day, the raw mill and finishing mill on two 10-hr. shifts, and all other departments on one 10-hr. shift per day. A 6-day week basis is used, with relief operators to make it possible. The plant balances well on this schedule and labor relations are very cordial.

The plant was designed by A. F. Miller, consulting engineer specializing in the cement industry, and was constructed under his supervision. Architectural plans were developed by Albert Kahn. The cement storage and packing building was erected by the Macdonald Engineering Company, but all the rest of the construction was done under local contract.

TABLE 1. SUMMARY OF DATA ON PEERLESS PORTLAND CEMENT PLANT

| | |
|---|---|
| Floors, plant | Concrete throughout, finished with ordinary cement. |
| Ceilings | In some cases these are the undersides of cement roof tiles supported on steel A-frames or monitor roof structure. Multi-story buildings have concrete ceilings. |
| Partitions | Gunite or troweled cement on metal lath. Storeroom in machine shop has wire mesh partitions on steel frames. |
| Stairs | In office wood. In plant either cast iron or Feralum steel safety tread type, with pipe hand rails. |
| Lighting | Direct system, ceiling lights, spaced as needed to give adequate illumination, 110 volt A. C. current. Lamps have metal reflectors and wattage is from 50 to 100. |
| Heating | Steam generated by waste heat, i.e., exhaust gases from kilns, is used in a central system. Reduced from 225 lb. to 10 lb. pressure for heating mains. Wall type radiators used throughout. Average temperature maintained is 65 deg. Fahr. in zero weather. Kiln house and finish mill are self-heating, clay house heated by salamanders north pack house not used in winter and hence not heated. Office has separate heater. |
| Heat line reducing valve | Foster regulating valve. |
| Boilers | Three 1000 hp. George T. Ladd Co., 3-pass, 2-drum vertical type waste heat boilers, each connected to a separate kiln. Heating surface 10,000 sq. ft. Each boiler delivers 24,000 lb. of steam per hr. at 225 lb. pressure, 100 deg. superheat when its connected kiln is making 1880 bbl. of cement per day. An auxiliary Ladd boiler, 500 hp., 3-drum vertical type, operates at 225 per cent of rating on pulverized fuel when one of the kilns is shut down. |
| Flue gas washers | Each boiler discharges exhaust gases through a Bayley Mfg. Co. scrubber, which washes the dust out before allowing gases to escape to the atmosphere. Dust is carried into river by scrubbing water. |
| Flue insulation | Sil-O-Cel lining, protected by one inch of special high temperature cement, in all the steel flues between kilns, waste heat boilers and gas washers. |
| Superheaters | One system in each waste heat line, before gases reach boiler, and one in auxiliary boiler. Made by The Superheater Co. |
| Economizers | One in each line between boiler and gas washer. B. F. Sturtevant type, 5000 sq. ft. of heating surface each. |
| Fuel feed and combustion control | Auxiliary Ladd boiler has Fuller-Lehigh burners and combustion control for pulverized fuel. |
| Boiler feed regulator | Copes system. |
| Feed water pumps | American Steam Pump Co., 4-stage, turbine-driven centrifugals. |
| Gas washer pumps | American Steam Pump Co., 3000 gal. per min. motor-driven centrifugals. |
| Feed water heater | Fulton open type. |
| Boiler instruments | Ellison draft gages; steam pressure gages, etc. |
| Draft fans | Bayley Mfg. Co., fans for controlling draft through or around boiler (in by-pass line). |
| Kiln coal feeders | Two Fuller-Kinyon 8-in. pulverized coal pumps feeding into 5-in. line. |
| Kiln draft fans | Three of Bayley Mfg. Co. make, drawing in 20 per cent of air, obtained warm from the kiln room. |
| Kiln fuel burners | Fuller-Lehigh make, and automatically drawing in about 80 per cent of the necessary air supply preheated from the hot clinker storage bed, which is of steel plate construction lined with firebrick. |
| Stacks | One for auxiliary boiler, 4 ft. 6 in. diam. and 72 ft. high. Three for boilers connected to kilns, 6 ft. diam. 72 ft. high. All are steel. |
| Steam pipe covering | Johns-Manville and Philip Carey make used on power and heating mains. |
| Coal handling | Track hopper and conveyor system 400 ft. long. Stearns Conveyor Co. make, Gutta Percha and Rubber Co. 30-in. belt. Timken bearings and Alemite lubricators. Also hopper fed by this conveyor, or by locomotive crane from dock if shipments come by water, and discharging to crusher and from thence to storage yard, where overhead crane distributes it, and carries it to hoppers in coal mill building, as required. Here it is weighed, dried, pulverized, delivered by means of a screw conveyor and elevator to a 30-ton storage tank, and blown into kilns and into auxiliary boiler. |
| Coal crusher | Pennsylvania roll-type, driven by 50-hp. motor through Link-Belt silent chain. |
| Coal weighers | Schaffer poidometers equipped with Dings magnetic pulleys. |
| Coal dryers | Two Ruggles-Coles Class 10-A. |
| Coal pulverizers | Two Raymond Bros. 15-ton roller mills equipped with dust collectors and driven by 220-hp. motors. |
| Coal feed to kilns | See kiln coal feeders, above |
| Ash handling | Manual labor at present. |
| Power facilities | A local turbo-generator plant, and a 500-kw. station (later perhaps to be 1000-kw.) in yard drawing current from Detroit Edison Co. at 2300 volts, supply power. In the power house are two Ridgeway Dynamo and Engine Co. turbo-generators of 3000 kw. capacity, 2300 volts, 754 amps, 3-phase, 60-cycle, 3600 r.p.m., with rater rate of 14 lb. per kw. hr. under 200 lb. steam pressure and 28 in. vacuum. Steam is supplied from waste heat boilers. Exciters are direct-connected. Part of power is used in 2200-volt motors and part in 440-volt motors. |
| Direct current auxiliaries | A Ridgway 150-kw. motor generator set, and a 150-kw. generator driven by a 225-hp. Terry steam turbine operating at 200 lb. pressure and 2000 r.p.m. deliver direct current at 250 volts for synchronous motor excitation, magnetic clutches, magnetic separators and similar service. |
| Condensers | Two Elliott-Earhardt 6000 sq. ft. surface type condensers equipped with Elliott ejectors, and with circulating and condensate pumps, the two pumps on each condenser being driven by a single 75-hp. 2200 volt, 865 r.p.m. Western Electric induction motor. |
| Condensate pump on heating line | W. E. Inman type. |
| Vacuum pump on heating line | Chicago Pump Co. make |
| Turbine room gages | U. S. Gage Co. steam pressure and vacuum gages. |
| Switchboard | Complete Westinghouse Electric and Manufacturing Co. installation. Oil switches and all high tension (2300-volt) lines are in basement of power house enclosed with wire partitions. |
| Compressed air | Two Ingersoll-Rand and one Worthington single stage compressors operating at 100 lb. line pressure. |
| Water supply | City system for drinking, processing and sewage purposes. River water for cooling, condensing service and fire protection purposes. |
| Fire pumps | American Steam Pump Co. make. |
| Service pump | American Steam Pump Co. 6-in. centrifugal. |
| Switches and control boxes | Square D type. |
| Cranes and hoists | Limestone storage—Two Whiting 80-ft. span traveling cranes with 3-yd. Williams clamshell buckets.<br>Gypsum storage—Whiting traveling crane with 1-yd. Williams bucket.<br>Machine shop—Whiting 5-ton overhead hand-operated crane.<br>Turbine room—Whiting 10-ton, 45 ft. span overhead, hand-operated crane.<br>Clay storage—Whiting overhead traveling crane with 3-yd. Williams clamshell bucket.<br>Clinker storage and coal storage—Whiting overhead traveling crane with 3-yd. Williams bucket. |
| Hand trucks | A few in bag storage house. |
| Tractors and trucks | Ford tractors and a number of trailers used about plant, also a Ford dump truck. |
| Elevators | Reliance Electric Elevator, 2000-lb. capacity, in bag house. |
| Conveyor system, coal | See coal handling, above. |
| Conveyor system, limestone | Boats are self-unloading. A Stearns conveyor, 2500-tons per hr. capacity, with 54-in. wide Gutta Percha and Rubber Co. belt, 610 ft. between end pulley centers, handles limestone. Drive is by 150-hp. motor. Belt has special take-ups at each end to compensate for 22 ft. belt stretch. Limestone is carried up between two storage yards and dumped where desired into either one by trippers. Timken bearings and Alemite lubricators on system. |
| Conveyor system, clinker | Chain Belt Co. 24 by 24-in. pan conveyor receives discharge from kilns and delivers it to storage, from where an underground Chain Belt Co. 30-in. pan conveyor carries it to finishing mill, discharging it into Fairbanks 5-ton weighing machines. A Richardson automatic scale feeds in gypsum. A 24 by 36-in. Chain Belt Co. bucket conveyor carries it to hoppers feeding rotary grinding kilns. |
| Conveyor system, cement | Link-Belt screw conveyors deliver ground cement to an elevator which feeds a Webster Mfg. Co. screw conveyor discharging it to 8 storage silos, each 34 ft. inside diam. and 85 ft. high, and with a total capacity of 200,000 bbl. Hand-operated slides allow cement to fall into four lines of reversible Webster 16-in. screw conveyors, discharging at either end into 18-in. cross conveyors, thence to bucket elevators, through sieves, into other screw conveyors (all of Webster make), and finally into Bates bag-filling machines. |
| Conveyor system, bagged cement | Belt conveyors receiving bagged cement discharge to pivoted belt conveyor truck-loaders leading to the driveway below, and raised and lowered to convenient heights by Drake push-button-controlled motor hoists. In south packing house the first belts are reversible and can feed a belt car-loader system. Conveyors are of Webster make and belts are from Diamond Rubber Co. |
| Conveyor system, reclaimed bags | Webster conveyor equipped with Diamond Rubber Co. belt delivers bags from automatic cleaner to man who sorts and stacks them. A 30-in. belt conveyor 150 ft. from center to center of end pulleys carries cleaned bags to the north pack house. |
| Packing machines | Seven 3-tube Bates machines. |
| Locomotive crane | One Orton and Steinbrenner crawler-tread crane for coal unloading from boats and general yard service; 15-tons capacity, 40-ft. boom with 10-ft. extension. |
| Yard locomotive | 12-ton Whitcomb gasoline engine for switching cars. |
| Dust and fume collectors | Three W. W. Sly Co. systems installed in bag-cleaning and pack houses and one in finishing mill. Coal mills also have dust collectors. |
| Fire extinguishers | Buhl Sons Co. hand-type, well distributed around plant. |
| Fire hose | Lines in kiln building, power house and coal mill. |
| Fire alarms | City alarm outside of plant. |
| Special cement equipment | Traylor Engineering Co. kilns 11 ft. diam. 175 ft. long, driven by 75-hp. variable speed motors with flexible couplings. Kilns lined with A. P. Green firebrick, and with Kruzite high alumina brick for 30 ft. in region of highest temperature.<br>F. L. Smidth Co., traveling agitator for caustic tank.<br>Richardson automatic scale for gypsum handling in finishing mill.<br>Two F. L. Smidth Co., 26-ft. clay mills driven by 75-hp. motors and Lenix drives.<br>Morris 6-in. centrifugal pump handles caustic and a Morris 3-in. centrifugal pump delivers caustic and clay mixture to raw mill. Former equipped with 50-hp. and latter with 10-hp. General Electric variable speed vertical motor.<br>Raw Mill has three 7 by 26-ft. Traylor Engineering Co., 3-compartment mills connected through 60-in. Cutler-Hammer magnetic clutches to 500-hp. Ridgway synchronous motors.<br>Morris 5-in. horizontal centrifugal pump with 30-hp. variable speed motor delivers slurry to slurry tanks.<br>Morris 8-in. vertical centrifugal pump with 50-hp. variable speed motor carries slurry to kiln house.<br>Morris 4-in. vertical centrifugal pump with 40-hp. variable speed motor takes slurry from tanks in kiln house to feed troughs above kilns.<br>Peerless (Palmer-Bee constructed) agitators in clay mills, slurry tanks, and storage tanks in kiln house.<br>Two 8 by 26-ft. finish mills driven by 650-hp. Ridgway synchronous motors through 66-in. Cutler-Hammer magnetic clutches. |
| Safeguards | Railings around all pits, mixing tanks, overhead passageways, etc. |
| Wash bowls | Individual porcelain. Standard Sanitary Mfg. Co. make. |
| Closets | Porcelain. Standard Sanitary make. |
| Urinals | 18-in. porcelain. Standard Sanitary make. |
| Toilet partitions | Cement on metal lath. |
| Drinking fountains | Pedestal bubbler type. |
| Plant communication | Bell Telephone System. |
| Time system | International Time Recorder system for in and out records. |
| First aid equipment | Cabinets, chairs, sterilizer, stretcher, etc. |

# Analyzing Net Worth in the Financial and Industrial Investigation

By ARTHUR ANDERSEN

*Arthur Andersen & Co.*

CAREFUL analysis of the net worth of a business will usually develop many facts bearing upon the financial policies of the management.[1] Such an analysis cannot be made purely from the viewpoint of figures, but includes a study of the conditions which have produced given values of net worth, and even goes beyond this investigation into a study of the form of net worth. It may be said that the analysis supplements the audit of all other sections of the balance sheet, by which the various assets and liabilities have been evaluated; and it serves to paint a word picture of the manner in which these assets have been created and these liabilities incurred. It is frequently more important to know the steps by which these things have been done than to know the actual amounts of assets and liabilities.

Another purpose served by the verification of the net worth section is to determine, so far as possible, the financial policies that have guided the management over the life of the corporation, in regard to such matters as depreciation, dividends in relation to earnings, surplus in relation to capital stock, etc.

## Sources of Net Worth

Net worth is acquired from the three primary sources of investment by stockholders, retention of earned profits, and capital profits. It is true in many cases, and inevitably so during the early stages of corporate existence, that investment by stockholders is the principal source of net worth.

An investigation of the investment by the stockholders in its broad sense, includes an examination into the inception and financial history of the company as well as analysis of its capitalization. The examination into the inception and financial history must be approached from two angles: from the financial aspect, and from the operating aspect. The examination from the financial angle should include the articles of incorporation, corporation minutes, entries opening the corporate general books, and other pertinent data relative to the inception of the present corporate organization. The result of this examination must be a clear and concise statement of the steps taken in the organization of the present corporation. Such a statement must show the properties acquired and the consideration given therefor, and must set forth this information in an orderly manner which will indicate the actual steps that were taken in the formation of the corporation.

## Operating Aspect

The operating aspect of this portion of the investigation is much broader in its scope and more fundamental in character. It approaches the problem from the business rather than the purely financial side. The analysis will show a history of the beginning of the business as distinguished from the inception of the corporation which may represent the consolidation of a number of independent companies. It is frequently found, for example, that a consolidation is effected of a number of companies which were hitherto competing. Subsequent to the consolidation the poorly situated plants may be discontinued, and production centered in the better situated plants providing their capacity is sufficient to take care of the combined requirements of the consolidated business.

The advantages arising from such a consolidation may be many, among which may be mentioned the possibility of producing a mechanically superior product through the combination of the best features of the hitherto competing products, the economies arising from operating plants throughout the year at a point which is near normal capacity, and the more skillful managerial control which may be secured by the consolidated organization, which has sufficient volume to employ men of ability with large experience in manufacturing products of this character.

It may be, on the other hand, that the consolidation was carried through in order to secure the more efficient and economical production of a number of manufactured articles which, although not competing in themselves, are of a character such that they may be most efficiently manufactured under one central control.

It may prove necessary to outline from a business standpoint the beginnings and principal steps in the growth of the several predecessor organizations up to the time of the consolidation, and from the date of the organization of the present corporation down to the end of the period covered by the present investigation. Such an outline will show, among other things, the development of the patents used by the organization and the principal steps in producing and estab-

[1] Previous articles on "The Industrial and Financial Investigation" by Arthur Andersen appeared in this journal as follows: December 1925, page 325; January 1926, page 17; February 1926, page 113.

lishing on the market the principal products of the company over a period of years.

### Analysis of Original Capitalization

Having secured a complete history of the beginnings of the company, both from the financial and operating standpoints, it now becomes quite desirable to make an analysis of the capitalization of the company from the date of the organization of the present corporation down to the date of the balance sheet. It is assumed, of course, in this connection, that the corporation under investigation has been organized a considerable period of years, so that a study of this character will furnish a real guide as to the manner in which the assets of the company have been created and the liabilities have been incurred.

In case the corporation under investigation has been in business for only a year or two, and it is desired to make a comprehensive investigation of the company for the purpose of a security issue, it will be necessary to go back of the date of organization of the present corporation and to make the analysis of the results from operations and the net worth section cover a considerable period for the predecessor company or companies. This is especially true in case the men responsible for the management of the present corporation were the guiding spirits of the predecessor companies. It will be assumed, however, that the corporation under investigation has been organized and has been in operation for a considerable period of years prior to the date of the investigation.

The analysis of the capitalization of the company should show the original investment of the stockholders, any additional investments made by the stockholders, the amount of stock dividends which have been paid and added to the capitalization, and finally the extent of the participation of the original organizers and present managers in the stock ownership.

### Three Major Considerations

The original investment of the stockholders will be represented by stock issued for any one of three considerations. First of all, the stockholders may have paid cash for their capital stock, and the liability for the cash investment of the stockholders may be carried in the capital stock account, or if a premium has been paid by the stockholders for the stock issued, the premium paid should be carried as paid-in surplus. It is clear that if stock has been issued for cash for a price at least equal to the par value of the stock, no investigation is called for except to make certain that no unfair discrimination was practiced between the stockholders and that the sale was duly authorized.

Second, stock may have been issued originally to the stockholders for fixed property or for other tangible considerations not cash. Such considerations may include accounts receivable or stocks of material and supplies, in case the owner of a small unincorporated business sells his property for capital stock of the new corporation.

Finally, stock may be issued for patents and goodwill. Stock so issued may represent an issue for actual and real consideration or may represent an amount taken by the original owners to reward themselves for having undertaken the enterprise. Profits in the flotation of the enterprise taken by the promoter are also frequently disguised and charged to patents and goodwill if stock is issued to the promoter in payment for his services. It is hardly feasible in this discussion to outline the steps to be taken in passing upon the validity of the issues of stock for property or other tangible considerations, or for patents and good-will. In general, however, it may be said that if the issues have been properly authorized, and if no fraud or collusion is indicated, there is no occasion to question the actual value of the consideration given for the stock as issued. However, the character of the property acquired in consideration for the issue of stock should be plainly shown, and if it appears that no real value was acquired through the issue, the report should so state.[2]

### Analysis of Subsequent Capitalization

Having analyzed the original investment made by the stockholders and having segregated the issues of stock between that issued for cash consideration, that for tangible property, and that for patents and goodwill, an analysis should be made of the additional investment by stockholders and segregated in the same manner. This segregation is important in the analysis of the additional issues for the identical reasons outlined in connection with the discussion on the analysis of the original issue of stock. As already indicated, stock issues may represent original investments, additional investments, and stock dividends. Stock dividends consist of nothing more or less than permanently impounded profits and must be related to the sources from which these profits came. They need to be considered at this point only for the purpose of completing the outline of the company's capitalization.

The foregoing outline of the analysis to be made of the issues of capital stock, and which is intended to cover both the issue of preferred and common stock, should also be made having due regard to certain questions, the answer to which will throw a considerable degree of light on the policies of those most actively interested in the company's business. In making such an analysis, consideration should be given to the portion of the total stock investment owned by the original organizers. If the original organizers have parted with a large portion of their original holdings or if their original holdings in the first instance were relatively nominal, it may be that they do not have sufficient faith in the future of the business to invest their own resources in it to any material amount.

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[2] A frequent method of indicating a qualification of this character is to show in parentheses after the words "Net Worth" on the balance sheet, the phrase "including intangibles." Such a phrase (immediately after the words "Net Worth") indicates that the value of the net worth is dependent to an extent upon the problematical value of the intangibles.

It is also well to have in mind the division of the stock investment of the original organizers between preferred and common stock. We frequently find the situation where the organizers have not put any cash or any real tangible property into the business, but have secured control of the company through the issue to themselves at time of organization of a large portion of the total common stock issued in consideration for patents, good-will and other intangibles. It may be in such a case that the preferred stock, which was issued and sold for cash, actually represents the only real equity back of the business, and if the original organizers have made no cash investment whatever in the business the question may well be raised as to the amount of faith they have in its future success.

The extent of the participation of the original organizers in the purchase of subsequent issues of stock is also an important consideration, since it indicates whether they have continued to support the company to the extent of their means, or whether they have drawn back and allowed outsiders to take all of the risk incident to the subsequent issues.

It is self-evident that the stockholdings of the active officers in charge of the finances and operations of the company furnish a most important guide as to the sincerity of the management in its protestations as to the success and future prosperity of the company.

### Growth of Net Worth

The answers to any questions of this character, however, must be considered with due regard to the individual case in question. It may be, for instance, that the original organizers of the business were men of small personal means who possessed little beyond some valuable patents and some good connections which would be very useful in the operation of the company. It may also be true that the principal officers of the company are men with no private fortunes, who have invested as much as they consistently could in the securities of the company, although their aggregate investment may be relatively almost nominal. In such cases it is evident that the character of the stock investment by the organizers or officers may furnish no reliable criterion as to their sincerity of purpose or their faith in the future of the company. In general, however, these questions are important and should receive careful consideration.

Since some portion, and often a considerable portion of net worth, is derived from the retention of earnings, it will be necessary to summarize the net profits by years from the date of organization of the corporation down to the date of the balance sheet. These net profits, of course, should be audited for the period covered by the investigation, that is to say, the period for which an audited income account is to be submitted. For the period prior thereto, the net profits per books may be used subject to any large adjustments that may be indicated as the result of the general analysis of the property and depreciation reserve accounts for the years prior to the beginning of the period for which the investigation is to be submitted and also subject to all that may be indicated by the investigation of the years actually audited.

It may be assumed, for instance, that a company has been in existence for a period of 15 years and that a 5-year income account is to be submitted in connection with the investigation. In such a case it is desirable to make a general examination of the property and depreciation reserve accounts from the date of organization, even though the property values may be stated on the basis of an appraisal as of the date of the balance sheet. Large errors, which would affect the yearly net profits indicated by this general examination of the property and depreciation reserve accounts, should be taken care of in the summary of the net profits.

Now that a history of earnings from the inception of the company to the close of the period covered by the investigation has been prepared, it is necessary to consider the disposition of those net earnings. There should therefore be prepared a summary of all cash dividends paid year by year from the date of organization down to the date of the balance sheet. It is quite desirable to have the dividends paid year by year set out in a column parallel to the net earnings year by year. Such a statement will indicate whether the company has consistently pursued a conservative and provident course in building up its net worth through the retention of part of its operating profits in the business.

The dividends on preferred stock frequently represent a charge which must be met if the company is to continue in successful operation, and dividends on preferred stock paid out of accumulated earnings of prior years are a necessary incident in the experience of a company which has issued preferred stock and which has wide variations in its operating results from year to year. So far as common stock dividends are concerned, however, it would seem to be the part of prudence for a company to conform the amount of its cash dividends on common stock from year to year to the actual surplus net earnings available therefor, after making provision for preferred dividends and after leaving some residue of earnings to be retained in the business.

### Net Worth from Capital Profits

The third and last source of net worth is to be found in capital profits. Capital profits may be segregated into profits actually realized and profits constructively realized.

Capital profits actually realized arise from transactions not directly connected with the regular business and frequently in connection with the sale of real estate, whether this real estate has been held merely as an outside investment or has been used in the operation of the business. In either case, the profit arising from the disposition of the real estate should, if the item is large, be shown as a capital

profit rather than as part of the profits arising from the regular operation of the business of the company.

An example of true capital profit is seen in the case of a company whose plant was situated on a piece of land that ultimately became very valuable as a terminal site for a large railroad. The price paid for this property under condemnation proceedings was sufficient to reimburse the company for the entire original cost of this property, including the buildings which had been erected on the site and had been in use by the company for many years. Since the company had never enjoyed sufficient earnings to set up any provision for depreciation, this sale made at a time when its manufacturing plant was pretty well worn out, furnished a happy solution to a problem that had become extremely difficult. A capital profit of this character which has been actually realized, may be included in the earned surplus of the company, of course. There is no question, however, that such a profit should be set out separately in any history of the earnings credited to surplus account during the period from the date of organization of the company to the date of the balance sheet.

### Capital Profits "Constructively Realized"

The situation is different, however, in respect to capital profits "constructively realized." Such profits may never properly be included in earned surplus, but should always be shown as capital surplus and should be designated by descriptive captions which will indicate the general nature of these profits. Such profits, when they do actually exist, represent, of course, the actual accretion in value of fixed assets through the operation of the law of unearned increment. If a building site purchased five years ago for $1000 is adjacent to sites of similar size and identical in every way which have been recently sold at prices varying from $2000 to $3000, it is quite evident that the value of this site also has increased with the passage of time.

In general, however, any capital profits arising through the appreciation of fixed assets which have not taken up on the books, should be supported by the results of an appraisal made by a reputable appraisal firm, or by some other definite and conclusive evidence that the appreciation claimed has actually taken place. Surplus credits arising from mere write-ups of the book values of the fixed assets should be reversed, if possible. Frequently, however, these write-ups have been authorized by the directors of the company who have adopted this method of improving their balance sheet. In such cases it may be likely that it will not be possible to reverse these write-ups. In such cases it is absolutely necessary to describe the item so clearly and definitely that no one can possibly be misled, or confuse such a write-up with actual capital profits which have been constructively realized.

### Interpretation of Stock Dividends

Stock dividends, do not, of course, either add to or subtract from the total net worth of a company, although their declaration may have an effect on the company's net worth as indicated by the market quotations of its stock. Actually, however, stock dividends furnish merely a means of transferring capital from one pocket to another. They represent a permanent investment of profits, rather than a distribution of profits, since the declaration of a stock dividend transfers a section of the net worth from surplus, where it is available for dividends to the capital stock account where it is not available. If a company is making large profits and growing rapidly it may be an indication of a very praiseworthy conservatism to declare large stock dividends which will have the result of increasing the stockholders' permanent investment and reducing the amount of the investment which is available for distribution in the form of cash dividends.

A question sometimes arises as to the capitalization of appreciation by means of a stock dividend. The legality of this procedure cannot be questioned; its propriety may constitute a very difficult question. It may be said, of course, that if the corporation were to reorganize and form a new corporation, it would be possible to issue stock of par or (in the case of no par value stock) declared value sufficient to absorb the entire amount of appreciation arising from the valuation of the assets. It may be argued, therefore, that the same result is being secured merely in another way by paying out the capital surplus in the form of a stock dividend.

In case capital profits created by an appreciation of the fixed assets have been paid out in the form of stock dividends, the fact that these stock dividends do not represent investment of actual earnings from operations, but rather merely the transfer of capital profits arising from the appreciation of fixed assets, should be set out clearly in the review of the company's net worth.

### Analysis of Capital Stock

Thus a greater or less proportion of the net worth may be represented by capital stock and a considerable importance attaches to the form given to this stock and to the classes of stockholders.

The position of the holder of preferred stock is largely that of a silent partner who has made his investment in order to secure a relatively high yield coupled with somewhat greater security than that possessed by the common stock. The common stockholder, on the other hand, frequently possesses the sole voting power and almost invariably the voting control. Eliminating the speculator who buys in order to profit by market fluctuations of the common stock, the investor in the common stock of an enterprise has put in his money either because of his active participation in the affairs and destinies of the business or because of his faith in its ultimate success.

Having outlined in a very general way the fundamental characteristics of each of the two principal classes of stock, it will be desirable to give considera-

tion to the special attributes of each class. Preferred stock is preferred in the event of liquidation and in the payment of dividends; that is to say, the agreement under which preferred stock is issued ordinarily provides that dividends shall be paid on the preferred stock before dividends can be declared and paid on the common stock. In many cases this provision for priority of dividend payments attaching to the preferred stock is made cumulative. In the case of cumulative preferred stock, it is stipulated that in the event dividends are passed on the preferred stock in any year or years, the preferred stock dividends in arrears shall be paid up in full before any dividends can be paid on the common. The stock agreement provides also that in the event of liquidation, voluntary or otherwise, the preferred stockholders shall be paid in full before any distribution of the assets of the corporation shall be made to the common stockholders.

### Characteristics of Preferred Stock

Preferred stock, however, is ordinarily definitely limited as to the rate of dividend return which shall be paid its holders. Certain preferred stock issues carry participating stipulations which tend, of course, to cause the stock to partake partially of the character of common stock. Ordinarily, the rate of return payable on preferred stock is definitely fixed and will not be increased in the event the company enjoys great prosperity and earns a high return on the capital invested. Preferred stock is hedged about with various protective provisions. In addition to the dividend and liquidation provisions previously referred to, it is frequently provided that the corporation shall maintain at all times a certain ratio of current assets to current liabilities and also shall maintain a certain ratio of net assets to preferred stock outstanding.

Preferred stock agreements frequently carry a sinking fund provision which provides for the retirement of stock over a period of years. These stipulations may and should require the company to make provision for these sinking fund payments through the appropriation of surplus net earnings for that purpose. Another stipulation designed to protect the interest of the preferred stockholders is frequently inserted to the effect that no mortgages or other fixed liens shall be placed upon the property without the prior consent of a two-thirds majority of the preferred stockholders.

As indicated by the foregoing discussion, it is evident that preferred stock possesses certain advantages and certain disadvantages for the investor. As contrasted with bonds, preferred stock yields a higher return. Its principal disadvantage, as contrasted with bonds, is that it is very much less well secured since the preferred stockholder is usually somewhat impotent in the event of disaster. He cannot foreclose in the event of default, as can a bondholder, and by the time he succeeds to the voting power, providing the agreement under which he has purchased his preferred stock provides for the preferred stock to become vested with the voting power in the event of default, he is likely to find himself compelled to submit to a scaling down process through a reorganization in order to get anything out of the *debacle*.

The protective provisions which perhaps appeared to make the preferred stock extremely safe will all prove to be worthless in the event the company starts to suffer heavy losses from operation, since an industrial company losing money may frequently suffer terrific losses which wipe out a large portion of the stockholders' equity before the preferred stockholder can secure control. Unfortunately no restrictive provisions have yet been devised which will prevent a company from losing money. In the event a company loses heavily through operating losses and the preferred stockholder comes into the voting control through default in preferred dividends, he frequently finds that the company has such a large floating indebtedness to the banks that if the business were to be liquidated, the settlement of the obligations to bankers and other creditors would absorb all the proceeds from the liquidation and leave him with little or no return on his original investment. In such an event he is perforce compelled to agree to the plan of reorganization designed by the creditors' committee, which perhaps provides for bonds to be taken by the principal creditors and for the preferred and common stockholders to make mutual sacrifices effected through reductions both in the amount of their stockholdings and the divident requirements of these holdings.

### Comparison Between Bonds, Preferred and Common Stocks

Contrasting the relative security of preferred stock with bonds, it should be remembered that mortgage bonds permit the investor, through his trustee, to step in and foreclose on the property in the event of default. When an industrial company already has a bond issue outstanding, banks will be very much more conservative and cautious about loaning the company money, and this situation tends to prevent a company from losing large sums and dissipating its entire net worth in operating losses before actually coming to a show-down. In case a company has no bonds outstanding, on the other hand, and has financed itself through the issue of preferred and common stock, banks may lend the company a considerable sum based on the security afforded by the capital investment of the preferred stockholders. In the event the sums advanced are dissipated through losses in operation, the bank can still fall back upon the capital investment of the preferred stockholders to secure payment of its claims and the preferred stockholders find themselves with little or nothing left of their original investment.

### Preferred Stocks

Contrasting preferred stock with common stock, on the other hand, the preferred stockholder enjoys greater assurance that his income will be steady and continuous and, in the event of reorganization, the con-

tributions levied upon him are much less drastic. On the other hand, his return is fixed and limited except in the case of participating preferred stock, which has already been referred to, and he can entertain no hopes that he will share in the melon providing his company achieves great success.

From the point of view of the corporation, preferred stock has certain advantages and certain disadvantages. Its yield is higher than the yield enjoyed by bonds, but, on the other hand, there is not the danger that the preferred stockholder, like the bondholder, will step in and foreclose in the event of default. As contrasted with common stock, the issue of preferred stock is frequently a source of weakness to the company since preferred stock dividends cannot be passed without impairing the company's credit seriously. This situation is accentuated in the case of a public utility that has sold preferred stock locally in considerable volume by virtue of a widespread customer-ownership campaign.

Contrasted with common stock, preferred stock has certain advantages and disadvantages to the investor. First and most important, it is more secure, there is less danger that the preferred stockholder will see his entire investment wiped out. Unless he is able to keep in close touch with the affairs of the company, or unless the company is nationally known and known to be extremely conservative in its management, it is unsafe for the small investor to invest largely in common stock, since he runs the very considerable risk of being wiped out in the event of disaster and is bound to suffer most severely in the event of reorganization. On the other hand, in the event of success, he can enjoy the full measure of his company's prosperity.

### Advantageous Use of Preferred Stock

There are certain types of enterprise which may properly use preferred stock issues as a means of raising additional capital. For example, this means may safely be used by old established companies whose earnings are relatively stable from year to year and who have large surplus capital represented by readily realizable assets. In the event a company does not desire to reduce its working capital to a narrow margin, but needs additional funds in order to carry out certain legitimate expenditures for the business, and especially where the common stockholders have great faith in the future prosperity of their company and do not wish to admit outsiders to a participation in these large anticipated profits, it might be highly desirable to provide the additional working capital required by means of an issue of preferred stock. Preferred stock issues are especially satisfactory means of raising additional capital for public utilities or other companies whose business is of such a character that the net earnings are relatively stable from year to year and can almost definitely be relied upon.

Preferred stock issues are dangerous, on the other hand, to new companies not yet firmly established, and to companies whose business is of such a character that almost of necessity they must anticipate that years of large earnings will be followed by years of low earnings or perhaps by years of losses.

In connection with our consideration of the different classes of stock it may be desirable to touch upon the two principal advantages to the corporation in the issue of no par value stock. First of all, since it has no par value, it may readily be sold at a price attractive to the investor without the corporation's incurring the odium incident to selling stock at a discount. It is especially useful in the event of reorganization in permitting the corporation to scale down the equity of the common stockholders to absorb a deficit, and to permit the rejuvenated company to start business with a clean slate and yet accomplish these desired ends without reducing the number of shares of stock held by the common stockholders. This latter purpose may, of course, be secured by scaling down the par value of stock. For instance, stock having a par value of $100 a share may be scaled down to a par value of $10, or even $1 a share. It is not necessary, of course, to issue no par value stock in order to effect the rejuvenation of the corporation in the manner outlined, but no par value stock appears to be the favorite medium for this purpose.

Some states regulate the par values of stock which may be issued, but a minimum par value stock often has all of the characteristics of a no par value stock. The form of the stock may be influenced by the prevailing type of market, and a company may be better able at a certain time to sell common stock to the public than preferred stock. Recently there have been considerable issues of stock which are a cross between preferred and common, usually having no par value, with a Class "A" series preferred as to fixed dividends and as to equity in the event of liquidation, but participating with Class "B" as to dividends after certain definite distributions have been made to the Class "B" stock.

In any contemplated financing, the securities offered should be of the type which will be readily absorbed by the public, will provide necessary capital for the company at the least cost, will not close the door to future financing, and so protected as to benefit the security holder without burdening or hampering the operation of the business. There is a mutual basis which may be worked out whereby all of the interests involved may be protected in case of trouble, with the security holder, however, occupying a prior position to the owners of the business in the event of a reorganization.

[The next topic which Mr. Andersen will take up is the analysis of operating statements. This article will be in the April issue and will show how to determine the accuracy, completeness and comparability of operating statements. Such important items as determination of profits, investigation of profit and loss, analysis of sales, relationship of selling and general expense, are taken up in detail.—The Editors.]

# Patent Pooling Develops Auto Industry

## Methods by which Manufacturers have Substituted Economic Co-operation for Mutually Destructive Litigation

By GEORGE F. BAUER

*Secretary, Foreign Trade Committee, National Automobile Chamber of Commerce*

ABOUT ten years ago, following the trying period of the Selden suit to determine the basic patent-rights underlying the automobile and other patent law suits, the manufacturers came to the conclusion that long years of litigation were ahead unless some plan could be devised for an exchange of patent rights. There was an appreciation of the fact that the large outlays for legal services for litigation could be more advantageously used in constructive efforts to better the car.

### Benefits from Co-operation

The manufacturers felt that the industry as a whole would be prosperous if the individual concerns were prosperous, and that the various products of the several companies could all be made without discouraging individuality in design, or in any of the features that make for individual sales advantages between the different companies.

The problem was to direct the power of all the engineers and production men toward the betterment of this new means of transportation in the belief that, if any cars were bad, the public would lose faith in the motor vehicle, and thus all manufacturers would suffer.

Accordingly, a plan was devised whereby more than 125 automobile manufacturers interchanged their patent rights without payment of any money consideration, all with a view to making the modern American motor car a composite of the best that the engineering brains of the industry could produce.

This plan became known as the Cross-Licensing Agreement of the National Automobile Chamber of Commerce. Of all the co-operative actions by the competitors in any one industry, this one, having for its purpose the making of a better product to be sold at the lowest possible price, is probably the most interesting.

### Men to Whom Credit Is Due

Most of the features of this broad piece of co-operation are the work of C. C. Hanch, whose able leadership of the National Automobile Chamber of Commerce Patents Committee resulted in motor vehicle builders being convinced of the advantages of the plan. In this move he was enthusiastically supported by Charles Clifton, head of the Pierce Arrow Motor Car Company and President of the National Automobile Chamber of Commerce, a leading exponent of co-operation in industry for the past fifteen years. The patents included were the major portion of all the important patents affecting the automobile. In a general sense, these patents were all "development patents" such as are always to be found in great number in the history of the development of any machine. To distinguish them from inventions that might be made later, of an entirely different character and representing radical departures from the existing engines, bodies and chassis, the inventions covered by these patents were called "Class A" patents.

The agreement specifically provided that it should not include devices that were applicable only to trucks, fire apparatus, tractors, ambulances and similar machines which were at that time still in a rather early stage of development. Neither did the agreement include design patents, the thought being that there was no necessity or reason for one manufacturer copying the ornamental design of another.

### Patents Which Were Excluded

If any inventions of an entirely radical character representing a total departure from the previous construction known in the art were made, the patents on them were not to be included within the agreement and were to be called "Class B" patents. These inventions were to remain the exclusive property of the manufacturers who developed them and it was stipulated that no such inventions could come into this class unless the inventions were developed within the organization of the manufacturer itself.

The broad feature of this whole plan was the idea that any automobile company that had been in production for a year or more, with a proper standing in the trade, and conducting its business in a legitimate fashion, was to be made welcome in the Chamber and given rights under all the patents of the other members who were parties to the agreement. In return it would contribute rights under such patents as it had taken out already or might take out in the future.

This plan did not discourage invention, because every patent taken out remained the property of the members, and while fellow members might use it, it could not be used without a license or royalty arrange-

ment with the owner by non-members or the manufacturers of tractors, stationary engines and the like. Always there was incentive to invent and improve, in order to surpass the nearest competitor. Even though the competitor could later copy the device, the inventing company always had at least a year's start on the other members and, being the first to develop and use a new device, benefited by the reputation for leadership as a reward. If the arrangement had been merely the case of one company being asked to put in a dozen patents against another company that had only one or two patents, the agreement could not have been concluded, but it was the case of putting in five or ten patents to receive the free use in return of over 700 patents owned by 125 manufacturers.

### AGREEMENT RENEWED IN 1924

At the end of the year 1924, the Cross-Licensing Agreement, which had then been operative among the members of the National Automobile Chamber of Commerce for ten years, was renewed for a further period of five years.

For the extension period since January 1, 1925, 777 patents are listed in the exchange. Of the patents of the old agreement operative during the first ten years, 221 patents had expired by lapse of time and 77 had gone out of the extension agreement because of the failure of their owners, the manufacturing companies, to continue in business.

While the old agreement provided for the exchange of new patents obtained during the period covered, as well as patents already in existence and owned at the time of the signing, the new agreement simply extended the licenses under the patents that were in the old agreement and owned by members on January 1, 1925. All new patents taken out by the companies after January 1, 1925 are not to be included. This means that it was not necessary to do any redesigning of cars in order to respect the patents that were owned by the members prior to that date.

### SPECIAL PATENTS DEPARTMENT

In order to carry out the objects of the Cross-Licensing Agreement, a special patents department was organized with a permanent staff of two competent attorneys and seven librarians and stenographic assistants.

A technical library of the first order became prerequisite for the proper administration of the work. Over 300,000 United States patents which record as many suggestions for the improvement of the automobile are now to be found in this library, so filed as to be readily available respecting each and every feature of the car. This collection is growing rapidly, the average increase being about 250 per week. It is significant that automobile patents constitute one-fourth of all those issued from the United States Patent Office.

Many books and periodical publications of the trade regarding the automobile, published in many languages, have been collected from all parts of the world and are constantly being received as issued. A majority of them give important and interesting data, and photographs and sketches of the latest automotive engineering developments. Therefore they constitute the most important portion of the collection. Great amounts of time and effort have been expended in many cases to obtain old books and complete files of old numbers of these publications.

J FINAL DRIVES—Continued

5. THRUST ROD.

6. RADIUS ROD.

7. DIFFERENTIALS. Includes means for permitting the road wheel to turn at the proper speed when the vehicle is on a curved path. Also bevel and worm gear drives for differentials.

8. IRREVERSIBLE. Includes special differential mechanisms, or differential substitutes, which are designed to reduce skidding, and to prevent one wheel from spinning when its traction is reduced.

9. DRIVING AXLES. Such features of the driving axles as the housing, driving hubs, etc., as are not classifiable under J.

K BRAKES.
Vehicle brakes, includes also disclosures of brakes of general application capable of use on the vehicle. Braking surfaces per se are classified in Q-S.

1. DRIVING WHEEL. Features common to driving and steering wheel brakes are placed in this sub-class rather than in K-2.

2. STEERING WHEEL. (Four Wheel Brakes.)

3. TRANSMISSION. Brakes applied to any portion of the transmission between the engine and the road wheels.

4. ELECTRIC.

5. FLUID.

6. CONTROL. Operating means where not modified by the specific type of brakes. Includes connecting rods, levers, pedals, ratchets, latches, adjusting devices, equalizers, etc. For anti-theft locks see P-17.

7. BRAKE COOLING.

FIG. 1 PAGE FROM LIBRARY'S INDEX OF CLASSIFICATION

### RECORDS OF FRENCH PATENTS

Copies of the French patents issued between 1895 and 1901, when French patents were not published, have been acquired and are a most valuable part of the library. This collection, the only set available in the United States, has proven its value in several cases of patent litigation.

Text books pertaining to the automobile or its component parts afford ready information on many special phases of design, construction and operation.

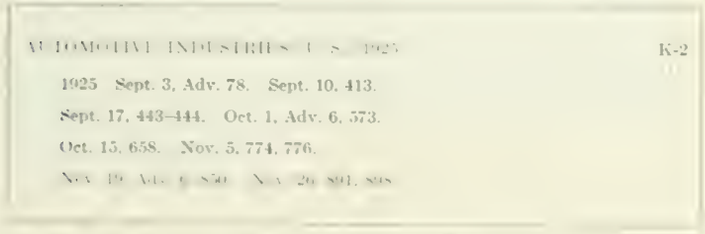
Catalogs issued from the day of the first "horseless carriages" to the present time, both foreign and domestic, have been retained in the files. Their value has been repeatedly demonstrated.

One wonders how this variegated material just enumerated is classified in such a manner as to be readily located when required. Solution of this problem was arrived at by developing a special index system in which the motor vehicle and its parts are divided into approximately 221 classes. Main classifications are denoted by letters of the alphabet, while subordinate classifications are denoted by numbers. Thus, in Fig. 1, the letter K is employed to indicate data pertaining to the general subject of "Brakes" and the numbers 1 to 7 are used to indicate various subdivisions of this general classification.

A specially trained staff have read all the patents,

periodicals, new text books, and similar material to analyze and properly classify them, and this work is constantly going on. Each new patent is read and properly classified upon its receipt and is filed away with others of the class to which it belongs. As a cross reference, a numerical card index of these patents is kept bearing the patentee's name, subject matter, issue date and classification. In instances where there has been litigation regarding a patent, reference to the cases is made on this card.

Each magazine or other periodical, as received in the library, is stamped with date of receipt and checked against the library's list to make certain that no issues are missing. These publications are then read by trained readers attached to the library staff. As items pertaining to patents or engineering practice and design are noted, classification symbols (see Fig. 1) are written in the margin opposite these paragraphs


AUTOMOTIVE INDUSTRIES [illegible] 1925 K-2

1925 Sept. 3, Adv. 78. Sept. 10, 413.

Sept. 17, 443–444. Oct. 1, Adv. 6, 573.

Oct. 15, 658. Nov. 5, 774, 776.

[illegible]

FIG. 2 PERMANENT CARD TO WHICH DATA IS TRANSFERRED

or illustrations. A small card bearing name of periodical, date of issue, classification symbol of item, and number of page on which it appears is prepared by the librarian.

These slips are sorted according to classification and periodical and turned over to typists, who place issue number, date and page number on cards (see Fig. 2) already in file in accordance with the classification, individual cards for publications being filed in alphabetical order within these classification groups. Magazines are then filed chronologically and alphabetically in binders on library shelves so that they will be available for future reference when the necessity arises.

## CROSS-REFERENCING OF OTHER DATA

Similar procedure is followed in cross-referencing unpublished French patents and new text books pertaining to the automobile.

It has been found desirable to add from time to time an index of information of purely historical nature and not necessarily bearing on patent or engineering procedure. To make readily available this additional information, five files are maintained, namely, Car History, Records of Shows, Records of Races, Group Specifications and a Miscellaneous File containing facts of historical interest not included in the four preceding topics. The final cards (see Fig. 3) are filed alphabetically by sub-topic, no reference symbols being used as in the case of patent and engineering references.

The reward received for this seemingly excessive amount of detail is ample though the facility afforded in obtaining quickly and with certainty all the information in existence anywhere concerning any specific subject. Slow and laborious examination of publications, page by page, volume by volume, is eliminated and guess work becomes a negligible factor. In other words, one can readily obtain what is wanted when wanted.

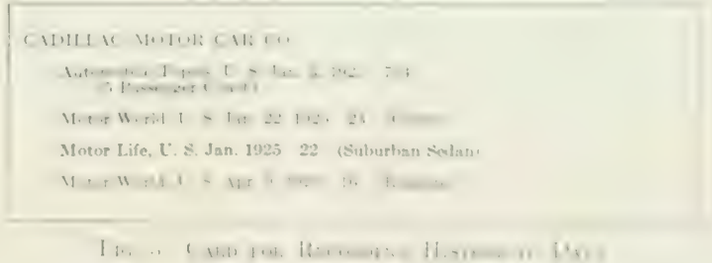
The benefits from this co-operative arrangement are highly important. Thus, manufacturers are able to determine the true scope and validity of any one of the 300,000 unexpired patents that pertain to the automobile.

## PATENT SEARCH ON NEW DEVICES

When a manufacturer contemplates a new thing he is afforded ample facilities to find out if he is likely to encounter legal trouble and is thus enabled to avoid a pitfall. If he should not have availed himself of this information and a charge of infringement is made against him, the manufacturer can have a search made to determine whether the charge is justified and be guided by opinion rendered to him. In the event that a patent infringement suit is brought, the manufacturer can use the Patents Department to secure the material necessary to show the state of the prior art, when the invention of the patent was made.

It may happen that the case is of general interest to many manufacturers and that it will be taken over on behalf of the industry by the Patents Department, when the issue is in doubt, to be decided as a test case—once for all. Certain cases may also arise when a large number of manufacturers may be interested in acquiring a license under a particular patent, whereupon terms are negotiated for a standard license at uniform terms for all.

The special technical library has been of great help in other directions, notably in the aid of research.


CADILLAC MOTOR CAR CO.

[illegible]

Motor World, U. S. Jan. 22 1925 24 [illegible]

Motor Life, U. S. Jan. 1925 22 (Suburban Sedan)

[illegible]

FIG. 3 CARD FOR RECORDING HISTORY DATA

Although the Patents Library is primarily available only to members of the association, permission is given for its use by anyone for purposes of research or historical inquiry. Frequent requests for such permission to use the library are made by outsiders. Several prominent European manufacturers have sought and found here the data they could not find elsewhere.

Putting aside the more detailed benefits, the outstanding fact is, that during the life of the Cross-Licensing Agreement, and its extension—years of the greatest success and keenest competition between members—there has not occurred a single lawsuit between them over patents, or anything else.

# Simple Storeroom and Storage Yard Methods

THE Southern Pacific General Shops in Sacramento is the largest shop industry west of the Mississippi, where 45 per cent of all the equipment on the Pacific Division is made as well as most of the steamships and ferry equipment and machinery for the Bay district. The shops have their own "money system" for exchange in the yards. This is necessary because the shops are divided into two departments, mechanical and stores.

Each worker is given ten "checks" when he enters the employ of the company, he buys his working tools with them, and is accountable for these checks and what they represent when he finally leaves the employ of the railroad.

The foreman has his "4218," or paper draft, with which he gets all the parts he needs for whatever he is assembling. Though 75 per cent of these parts have been manufactured in the shops, they are turned over to the stores department and belong there as definitely as if these two departments were separate concerns.

FIG. 1 FURNACE USED FOR MELTING BABBITT FROM LOCOMOTIVE BEARINGS

This system is the basis of the cost of production, a regular system of bookkeeping and pricing is kept according to the fluctuations of the regular markets, and if a locomotive costs too much, the officials can account for the actual loss of each part.

The laboratory where all the tests are made is one of the most important factors in the working of the detailed system.

"Why was that wreck?" "How did that engine break down?" The laboratory determines whether the materials were at fault or whether it was poor workmanship that brought trouble. Through its system of identification, the railroad company can narrow its search down to the person basically responsible practically every time.

In the yard is a special furnace used to melt babbitt lining in locomotive bearings. As shown it is provided with a hoist for lowering bearings into the furnace and removing the shoes after the lining has been melted off. (Fig. 1.)

FIG. 2 FLUE RATTLER FOR CLEANING LOCOMOTIVE FLUES

Fig. 2 shows a flue rattler in one corner of the yard used for cleaning locomotive flues.

Turning back to the stores department, Fig. 3 shows the method of laying out link chain to permit of rapid counting of stock, and at the same time provides an orderly method of arrangement. The chain is coated with an anti-rust solution to prevent rusting from exposure to the weather.

Each length is provided with a tag, giving the number of feet, thus enabling the monthly stock record to be taken quickly and easily by consulting these tags. The wooden platform on which the chain is stored is raised a little above the ground, and is 30 ft. long.

FIG. 3 METHOD OF STORING LINK CHAIN TO PERMIT RAPID COUNTING

# Safety Progress Requires Better Records

## A Definite Suggestion for Developing Standard and Adequate Accident Data to Promote Safety Work in Manufacturing Plants

ACCIDENT prevention has been promoted energetically in this country during the current century, and especially during the last 12 or 15 years, but lack of uniformity in making accident reports and in keeping accident statistics has left us without a satisfactory record of experience. As a result, we are not sufficiently supplied with useful standards, resulting from past achievement, by which to measure our present efforts and plans for the future.

### Importance of Safety Work

Widely experienced leaders in industry agree that industrial safety stands out today as a problem of pre-eminent importance, and that no useful channel should be left unutilized for its solution. The significance of this problem to the welfare of the nation is made evident by figures of Carl Hookstadt, of the United States Bureau of Labor Statistics, given in the "Monthly Labor Review" of November 1923, which place industrial accidents in this country at about 2,500,000 per annum, working days lost at well over 200,000,000, and loss in wages at over $1,000,000,000. This sum is increased greatly when medical cost, disturbance to industry, human suffering, disruption of homes, and other losses which arise as a result of accidents are added.

### Unsatisfactory National Statistics

In determining his figures, Mr. Hookstadt unfortunately was compelled to resort to estimates based upon comparatively slender statistical information. Indeed, by necessity his conclusions were obtained largely through analogy, using as a starting point the relatively excellent statistics of the railroads which the Interstate Commerce Commission has available, those of the mines to be obtained from the United States Bureau of Mines, and figures gathered by some of the states, organizations of casualty insurance companies, and the National Safety Council.

In 1922 the National Government issued a bulletin, entitled "Statistics of Industrial Accidents in the United States." This was prepared by Dr. Lucien W. Chaney, also of the Bureau of Labor Statistics, but who is particularly well known by reason of his fine pioneer work in gathering accident statistics of the steel industry. Though this bulletin was prepared primarily for the purpose of depicting the industrial accident situation of the country, it is even more valuable as a means of bringing home to us the knowledge of the widespread weakness to be found in accident reporting and in the analysis and recording of accidents by public authorities.

The fundamental table of the bulletin is a résumé of numbers of fatalities and other accidents, by states, and was compiled from information received from state authorities to whom, in most of the states, the industries are required by law to report. In this table the author was compelled to insert a column entitled "Scope of Data," in order to indicate the varying practices of the states in gathering the reports. Quotations of a few of the notations in this column are enlightening, thus: "Accidents of one day's disability reported ....."; "No provision (by law) for reporting accidents"; "Law compulsory as to mines, elective as to other employment"; "Law elective"; "Number of claims (compensation) filed"; "Accidents of more than two days' disability reported"; "Accidents of more than two weeks' disability reported from certain industries"; and so on for the 42 states from which data was obtainable.

### Footnotes Further Prove Lack of Uniformity

To cap the difficulties of the author, he had to add various footnotes which further qualified the figures, such as "estimated"; "includes fatal accidents, the number of which is not reported"; "covers 10 months only"; "records destroyed by fire," etc. In addition, there is much variation in the field covered by the state reports, thus a few include agriculture.

For 22 states the accident classification was by industries; for 18 states, by cause; for 12 states, by nature of injury; for 11 states, by location of injury; for 2 states, by amount of exposure; for 3 states, by severity.

The fact that the number of fatalities shown in this table is 9394, while the carefully estimated annual number given in the "Monthly Labor Review" is 21,232, illustrates the serious inadequacy of statistical information from the standpoint of the nation at large. Indeed, the figures are so unsatisfactory that they are of comparatively small value for charting the effect of safety prevention work or as a guide to future activities.

### The Situation in Industry

In industry itself much the same condition exists as for the states. For some years reports of accidents have been reasonably complete in many respects in the mining and railroad industries, and also in the iron and steel industry. Therefore, valuable, compara-

tive statistics are available for each, particularly for the past 15 to 25 years. These data have been of great value to the safety work in these industries and, for example, without question have vitally aided the railroads to reduce fatalities numbering 10,396 in 1911 to 5996 in 1921. In the case of the greater part of the other industries no such complete or comparable statistics are obtainable as in the three named.

### Individual Establishments

Individual establishments in all industries which have taken up the safety problem earnestly have made great improvements, often cutting down their accident frequency and severity from 50 to 75 per cent or more, but they usually have done so without the advantage of being able to compare their own experience with other concerns in the same or other business.

Except in a few industries, it is seldom that two establishments of similar nature keep their records in such a manner that they are, to a large degree, helpfully comparable. It is common for each one to build up its own forms for accident reports, or draw them in accord with the legal requirements of the state within which it is located. The definitions of terms used are apt to vary, and the methods of classification and analysis differ. Thus, one establishment may record "all accidents," while another may use the same term, but have a different interpretation of its meaning. One company may carefully record "exposure to hazard," while another, with very irregular working time or variable number of employees, may omit this essential entirely. One company may make and record careful analyses of the causes of accidents, and another in the same business may do equally well, but use such different classifications and terms that comparison is impossible. Similarly wide differences may occur in the parts of accident reports, analysis, and records which refer to the nature, location, or responsibility for accidents, etc. In some cases no helpful records whatever are kept. Thus it is seen that in a large part of our American industry, an establishment is often unable to obtain records of the helpful experience it has a right to expect from its state or the National Government, or even from other concerns in the same business.

### Small Amount Accomplished

Something has been done to develop standard definitions and forms for accident reports, analysis, and records, particularly by the National Government, the International Association of Industrial Accident Boards and Commissions, and other organized bodies, such as the National Safety Council and casualty insurance associations, but this work is far from complete, and even where such standard definitions, forms, and practices have been set up they are so much honored in their disuse that the fact remains that industry is still seriously handicapped in America in its work of promoting safety.

Further, though the Association of Accident Boards and Commissions, named above, has given excellent service in the field under consideration, it was organized primarily to develop sound accident compensation practice, as illustrated, for instance, in its excellent recent work on a "Standard Permanent Disability Schedule." Also, it is composed largely of United States and state officials, and has few representatives of industry in its membership, so that it is not in a strategic position to get its recommendations adopted except by the force of law. This disability, however, does not affect the National Safety Council, which contains a large and influential industrial representation in its membership.

Standards or codes for safeguards and safe practices have been much more fully developed and widely used than have been methods for uniform or standard accident analysis and recording. Thus, during the first half of the last decade, the State of Pennsylvania, with the aid of representatives of industry and others, developed a score or more safety codes, which covered the most serious industrial hazards in the state. Other states and the United States, as a whole, have also been active in this field. Some businesses, among which are electrical railroad, insurance, and other organizations, for several decades have been systematically creating and adopting codes involving safe practice, and just before the "great war," the American Society of Mechanical Engineers added to its organization a permanent Safety Committee.

In 1917 the American Engineering Standards Committee was formed, strongly supported by both the government and industry. This organization has already developed standard safety codes covering a very wide variety of industrial danger spots, which are largely accepted by industry as "American Standards of Practice."

### A Possible Solution

In view of the excellent and effective work which this Standards Committee already has accomplished in creating accepted standards for safeguarding and safe practices, is it not the body which should also direct the allied and fundamentally important work of creating standards essential for the purpose of analysis and recording of accident experience? Should it assume this added responsibility, it might wisely call to its aid as joint sponsors the National Safety Council and the International Association of Industrial Accident Boards and Commissions. Thus, there would be brought together, under the direction of the recognized standardization body of the country, the two organizations most competent to handle the details of the work.

An additional advantage which would accrue through the service of these two last named organizations would arise from the fact that one would be potent in having the resultant findings accepted by the public authorities of the nation and states, and the other would be equally so in obtaining their adoption by industry.

# The Guide to Latest Information

## One Hundred Best Selections for March*

By THE EDITORS

PUBLISHED material of value to managers and operating executives in manufacturing plants shows decided swings into definite fields from month to month. Books and articles reviewed for the present issue of MANUFACTURING INDUSTRIES, from which the selections below were taken, yielded a large group of items classed under the heads of: Organization, Management and Administration; Power Generation and Transmission; Production Control; Health and Safety; and Financial Control.

As the largest proportion of books and articles which find their way into print answer the current demands of industrial executives, these topics are evidently the ones considered of greatest importance at the present time. The selection below represents the best up-to-date information available, and a careful scanning of the items is recommended as a time-saving guide to current reading.

## Industrial Buildings and Plant Maintenance

### Buildings and Equipment

**Cadillac's the Last Word in Foundry. 658.2**

Max Enos. Brief description of the new combined brass, aluminum and iron foundry of the Cadillac Motor Co. designed after a thorough study, by three experts of 30 American foundries, to determine the best equipment and arrangement. *Michigan Manufacturer and Financial Record,* Jan. 23, 1926, pp. 145-7.

**Engineering Services at Fort Dunlop. 658.2**

Description of the steam, electrical, water and hydraulic plants at the Birmingham works of the Dunlop Rubber Co., Ltd. *Power Engineer,* Jan. 1926, pp. 15-20. Illus.

**How to Get the Most From Your Lighting System. 658.24**

Roy A. Palmer. Discussion of what better lighting costs, how much better lighting is worth to a plant, and maintenance methods that will improve faulty lighting conditions. *Industrial Engineer,* Feb. 1926, pp. 75-8. Illus.

**New Creosoting Plant of Southern Pacific Railway. 658.2**

A. F. Bonnalie. General features of new $520,000 plant installed recently at West Oakland, Calif. *Engineering and Contracting (General Contracting),* Jan. 20, 1926, pp. 37-41. Illus.

**Oxygen and Acetylene Piping. 658.28**

W. A. Slack. How to make a survey of the plant so that oxygen and acetylene pipe lines may be installed at least cost and to the best advantage. *Welding Engineer,* Jan. 1926, pp. 33-4.

**Peerless Portland Cement Pioneers in Plant Design and Layout. 658.2**

John Gillespie, secretary and treasurer of the company, describes the new and modern plant recently put into operation. Thorough study of layout and extensive use of material handling equipment have been made. Table lists construction and equipment details. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 195-200. Illus.

### Maintenance and Repair

**Keeping a Daily Record of All Equipment Failures. 658.581**

J. H. Gallant. How the Canada Cement Co. of Belleville, Ont., has reduced the number of delays and amount of time lost by making possible a close check on the causes and frequency of breakdowns. *Industrial Engineer,* Feb. 1926, pp. 79-80. Illus.

**Maintenance Practice and Organization Methods. 658.58**

G. A. Van Brunt. Analyses of the handling of this kind of work in 80 industrial plants. Selection and care of equipment, handling of supplies, and placing of responsibility for execution of work. Includes an extensive table. *Industrial Engineer,* Feb. 1926, pp. 57-60. Illus.

**Reducing Operating and Maintenance Costs. 658.58**

Outline of 13 replies received in answer to questions as to how certain industrial plants have cut expenses by efficient organization of inspection and maintenance work, standardization of equipment, and use of modern testing and repair devices. *Industrial Engineer,* Feb. 1926, pp. 66-74. Illus.

## Organization, Management and Administration

**Administration of Industrial Research. 658.57**

Edward R. Weidlein. Methods in the Mellon Institute of Industrial Research, at Pittsburgh. Scope of research management; definition of organization; principles of management; functions of laboratory organization; selection of research men; organizational divisions; co-ordination of research effort. *Industrial and Engineering Chemistry,* Jan. 1926, pp. 98-101.

**American Engineering Standards Committee Year Book. 1925. 658.516**

Pamphlet. 72 pp. Reviews year's work; outlines field, purpose and method of carrying on activities, lists and describes all projects, both approved and under way; gives names of co-operating bodies, sustaining members, etc

**Forecasting, Planning and Budgeting in Business Management. 658**

Percival White. McGraw-Hill Book Co., New York. 267 pp. $2.50. Business has adopted planning, the most significant feature of scientific management as a basic principle. Executives must forecast, schedule, plan and make budgets in order to operate enterprises successfully. The author shows how the fundamental principles have been applied in a practical way. He also points out how the general basic data furnished by the various forecasting services can be usefully applied to the problems of the individual business. Chapters cover: Factors in forecasting; sources of data; forecasts of general business; the business cycle; statistical analysis; graphic interpretation; correlations; planning; budgets; planned purchasing; production; marketing; management.

*The articles and books classified by topic and briefly described are selected from current periodicals by the editors of MANUFACTURING INDUSTRIES as those most worthy of serious attention by executives, managers and engineers of manufacturing plants. The issues are there read, upwards of [illegible] industrial magazines and the publications of [illegible] professional societies and book publishers. The editors will be glad to furnish additional information and references on request.

The number at the right of each item is the index number in the Dewey Decimal Classification system. If articles are clipped and filed according to these numbers, like subjects will automatically group together and related subjects will follow in logical sequence.

The books and pamphlets classified can be procured from the Ronald Press Company or their respective publishers. If books of other publishers are ordered from the Ronald Press Company, money must be accompanied by cash, plus 25 cents per book for transportation charges.

Photostat copies of articles printed in books, periodicals or any magazine whose address is not published at a price of 10 cents per page, by addressing the Engineering Societies Library, 29 West 39th Street, New York City, with whom we have arranged this service. Remittance must accompany the order. When ordering photostats please quote from the index: (1) Title of article; (2) Index number; (3) Name, date and page [illegible] in which the item appears.

**Getting the Most Out of Your Machine Tool Dollar. 658.27**

Percy S. Brown. The point of view of the Corona Typewriter Co., Inc., to discover and utilize the best of new machine tools and equipment. *American Machinist,* Feb. 4, 1926, pp. 183-6.

**Graphic Methods for Presenting Business Statistics. 311**

John R. Riggleman. McGraw-Hill Book Co., New York. 231 pp. $2.50. Intended for the reader who wishes to understand the most useful methods of presenting business data. Technical terms and mathematical treatment have been omitted. Specific uses and limitations of various forms of charts are explained, the plan being to develop a text which would find direct use by the business executive. The following topics illustrate the nature of the discussion: Technique of drawing statistical charts; chart planning; comparisons of size; historical time series; frequency distributions; correlation; geographical distributions; duplication, reproduction and display.

**Labor's Ideals Concerning Management. 658.3**

William Green. Statement of labor's attitude toward industry and industrial processes made by the president of the American Federation of Labor. It is an appeal for thorough understanding and co-operation on the part of all those associated in industry. *Bulletin of the Taylor Society,* Dec. 1925, pp. 241-53.

**Machine Tool Needs of the Industry. 658.27**

R. M. Hidey, works manager, White Motor Co., shows the demand existing for multi-purpose machine tools, the need for more adequate safety guards, and the possibilities of vastly increased sales of machine tools if the builders would co-operate heartily with such industries as automobile manufacturing. *Michigan Manufacturer and Financial Record,* Jan. 23, 1926, pp. 134-5.

**Market Analysis Checks Over-Production. 658**

John N. Willys, president of Willys-Overland, Inc., tells how the automobile industry, in general, and his own plants, in particular, have avoided the evils of over-production by daily and semi-monthly reports from the sales firing-line, on which production schedules are based. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 165-8. Illus.

**Method of Analyzing Business Data. 658**

Bureau of Business Research, University of Illinois. Pamphlet. 46 pp. Shows method whereby the individual manufacturer or executive may analyze his own data in a manner similar to that used in the analysis of nationwide figures of general conditions. The routine offered has three steps: (1) Arrangement of the sequence of operation of competition; (2) Exploration of each step in the process; (3) Design of blank forms to be used for the clerical work with a minimum of technical supervision.

**Original Dollar in Hupmobile Grows to $2000. 658**

A. Motelle. *Automotive Industries,* Jan. 21, 1926, pp. 90-3. Illus.

**Patent Pooling Develops Auto Industry. 608**

George F. Bauer. Methods by which automobile manufacturers cross-licensed over 700 patents and for the past 12 years have avoided expensive and destructive litigation. Comprehensive patent library of the National Automobile Chamber of Commerce is described. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 207-9. Illus.

**Problems of Seasonal Manufacture. 658**

C. C. Hermann. *Canadian Machinery,* Jan. 21, 1926, pp. 9-11. Illus.

**Progress of Waste Elimination in the Paper Industry. 658.5671**

George D. Bearce. Sources of waste; reduction of white water losses; utilization of wood refuse; tests of white water losses; stock reclamation; stream pollution. *Industrial Management,* Feb. 1926, pp. 112-5.

**Purpose as a Psychological Factor in Management. 658:15**

Ordway Tead. Discussion of the methods by which integration of group purposes can be effected in industrial operation. Bulletin of the Taylor Society, Dec. 1925, pp. 254-67.

**Some Recent Applications of Motion Study. 658.542**

Joseph A. Piacitelli. A record of economies which resulted from the standardization of methods and equipment in the production and shipping of roofing materials. *Bulletin of the Taylor Society,* Dec. 1925, pp. 268-76. Illus.

**Special Machine Tools for Best Work. 621.9**

C. M. Conradson predicts that the near future will see the universal use of single-purpose machine tools in the auto industry as contrasted with standard designs; machine arrangements to eliminate all unnecessary handling; individual motor-drive and power handling of machines; power mechanisms for handling parts. *Michigan Manufacturer and Financial Record,* Jan. 23, 1926, pp. 140-3.

**We Lowered Prices in Spite of Higher Costs. 658**

H. P. Way. Methods used by the Van Camp Packing Company to bring about a 75 per cent reduction in production costs and 142 per cent increase in sales. *System,* Feb. 1925, pp. 201-5, 263, 264, 266. Illus.

**"Working for the Customer" at the Crompton Company. 658**

Douglas G. Woolf. Methods of the Crompton Co. to correlate all plant activities and secure the result of successful manufacturing and merchandising of quality goods at a fair profit. *Textile World,* Feb. 6, 1926, pp. 201-2.

# Power Generation and Transmission

## Fuel

**Oil-Fuel Versus Coal for Land Boilers. 621.18**

R. E. Light. Advantages of each over the other, and an overall cost analysis of three comparative schedules from representative types of boiler plants. Coal is shown to be more economical. *Power Engineer,* Dec. 1925, pp. 449-51. Illus.

**Preparation of Commercial Coal. 622.7**

Thomas Fraser. Sizing, machine loading, hand picking, losses in preparation, available separation processes, screen test tables. *Coal Mine Management,* Jan. 1926, pp. 23-8, 53.

## Power Generation

**Cheap Power for Cement Making. 621.18**

Description of power plant and equipment of G. and T. Earle, Ltd., Wilmington, Hull, England. *Power Engineer,* Dec. 1925, pp. 455-9. Illus.

**Cost of a Short-Sighted Power Policy. 658.26**

Andrew F. Sheehan. How one concern saved 10 per cent on its power by installing new boilers but passed up a $13,000 annual saving by refusing to make changes in its engines and other power equipment. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 193-4.

**Developing Water Power for Factory Use. 621.2**

F. Johnstone Taylor. In developing water power it is necessary first of all to estimate closely the capital cost of the project, and then to make sure that the power will be available at all seasons of the year. *Power House,* Dec. 20, 1925, pp. 17-19.

**Economics of Pulverized Fuel and Stokers. 658.26**

H. S. Colby. Comparison and relative advantages should be governed by total steam costs which are influenced by load factor and its bearing on fixed charges. *Power Plant Engineering,* Feb. 1, 1926, pp. 202-6. Illus.

**Fuel and Lubricating Oil Purification Reviewed. 621.18**

Lee H. Clark. Methods and advantages of purification are described. *Oil Engine Power,* Dec. 1925, pp. 700-2. Illus.

**Hydro-Electric Power for Metal Working. 621.2**

Description of the new power plant of the Stanley Works built on the Farmington River. It is designed to tie up with the network of high-tension power circuits of New England. *Iron Age,* Feb. 4, 1926, pp. 340-1. Illus.

**Modern Ways of Increasing Power Plant Furnace Efficiency. 621.18**

Francis Juraschek. Equipment and methods for using pulverized coal and for applying the waste heat in flue gases to preheat air for combustion. *Industrial Management,* Feb. 1926, pp. 119-124. Illus.

**Oil Engine Helps to Carry Heating Load. 658.25**

Universal Machine Co. passes exhaust gases from Diesel engine through waste heat hot-water boilers and thereby heats plant in mild weather. This system is operated in series with a main hot-water heating plant a block away, in severe weather. Method saves two tons of coal per day. *Oil Engine Power,* Jan. 1926, pp. 30-1. Illus.

**Powdered Coal Universal Fuel at American Spiral Pipe Works. 621.18**

The equipment and rules for safe operation for burning powdered coal. *Power*, Jan. 26, 1926, pp. 126-30. Illus.

### Power Transmission

**Handling Maintenance and Repairs on 4000 Motors. 658.262**

William Reinsmith. Methods of the Studebaker Corp. Includes work on 700 portable electric tools, 28 battery tractors and 35 cranes with details of how the work is organized and economically handled. *Industrial Engineer*, Feb. 1926, pp. 50-6, 81. Illus.

**Mechanical Maintenance Policies and Practices. 658.262**

Hugo R. Slipeck. Methods worked out at the Deering Works of the International Harvester Co. to keep the plant and its power transmission equipment operating at high efficiency with low upkeep. *Industrial Engineer*, Feb. 1926, pp. 61-65. Illus.

**Search for Economy Alters Motor Drive. 658.262**

R. H. Rogers. Shows how group and individual drive, changes in machine design and belting have cut cost reductions, and how fractional drive, or the application of several motors to one machine, is still further cutting costs. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 171-4. Illus.

**Tendencies in Electric-Motor Control Installations. 658.262**

J. Elmer Housley. Examples of good and bad practice in the installation of switching equipment as developed by the Aluminum Company of America. *Power*, Jan. 26, 1926, pp. 134-5. Illus.

## Marketing and Distribution

### Advertising

**Attention Value of Newspaper Advertisements. 659.131**

Richard B. Franken. Association of National Advertisers, New York. 55 pp. $1. This study was originally made for the members of the Association of National Advertisers, Inc. After its original issue, however, it was deemed of sufficient value to warrant a larger edition, and is now available to the general reader. The purpose of the study which has yielded this book is a report as to proved established results in a form to be of practical use to the advertiser and the advertising profession. Also, to show the method of technique for measuring certain types of human behavior and finally to stimulate interest in scientific research in advertising along psychological lines. The investigation was made primarily in three New York City newspapers, and therefore deals with newspaper rather than magazine advertising.

### Selling

**Marketing. 658.83**

Edmund Brown, Jr. Harper and Bros., New York. 503 pp. $3. Presents actual practice in the different trades. Based on the premise that raw materials and manufactured products cannot be discussed separately, but that any one material, as cotton, should be followed through its manufactured goods state, as in fabrics and clothing, to complete a full marketing cycle. After laying down the introductory approach to marketing problems the book analyzes certain basis trades—wheat, cotton, canned goods, leather products, coal, steel, lumber, industrial equipment, etc. It then takes up: Organized exchanges and future trading; wholesale distribution; retail distribution; and marketing policy—market analysis, specialties, discounts, installment selling, resale price maintenance, selling direct to retailers or to consumers, and the exclusive agency.

**Preparing a Sales Manual and Making it Effective in Selling Work—II. 658.807**

R. C. Hay. Deals with methods for securing the material, writing the manual in an interesting way and making the publication effective. *Printers' Ink Monthly*, Feb. 1926, pp. 37, 110.

**Problem of Selling the Product. 658.8**

Harry H. Bassett. Points on market analysis and the fitting of salesmen for their tasks are presented by the president of the Buick Motor Co. *Michigan Manufacturer and Financial Record*, Jan. 23, 1926, pp. 86, 90.

**Production Men Now in Sales Picture. 658.8**

John C. Edwards. Outline of policy and methods of the Dodge Manufacturing Corp. The thought is that the engineer can and should help complete sales. *Class*, Feb. 1926, pp. 15-18.

**Salesmanship Applied. 658.8**

Paul W. Ivey. A. W. Shaw Co., Chicago. 333 pages. $5. Material in this book constitutes a course in salesmanship known as the "Paul Ivey Salesmanship Institute," which has been held under the auspices of chambers of commerce, service clubs, university extension divisions and other organizations. The lectures have been incorporated into this book for the benefit of salesmen and sales executives who have been particularly interested in the course. The sales ideas embodied are drawn from the experience in training sales forces for manufacturers, wholesalers and retailers.

**Warehousing. 658.784**

H. A. Haring. Ronald Press Co., New York. 778 pages. $10. Trade customs and trade practices, financial and legal aspects are features of this [illegible] which completely covers the business relationships of warehousing. The volume presents organized information on merchandising, transportation, banking, legal restrictions, insurance and related topics. It has been prepared for those who are on the commercial side of warehousing, warehouse owners, owners of goods, banks and underwriters. It is also for those who find warehousing a necessary adjunct in their business operation, manufacturers, merchants, sales and advertising managers, railroad executives and members of commodity exchanges. No other sources of such organized information exist dealing with one of the basic and rapidly growing industries.

### Packing, Shipping, Transportation

**Bennett on Package Standardization. 658.788444**

Russell W. Bennett dissents from view that package standardization is a shipper and grower problem and claims that it is a manufacturers' problem. *Barrel and Box*, Jan. 1926, pp. 24-5.

**Buying and Handling $134,000,000 Worth of Transportation. 656**

Wayne E. Butterbaugh. The traffic department of the Ford Motor Co. and how it functions. *Industrial Management*, Feb. 1926, pp. 100-4. Illus.

**Plywood Box from the Log to the Finished Product. 674**

Harry N. Knowlton. Woods used, drying, gluing, printing, resistance features and methods of nailing. *Barrel and Box*, Jan. 1926, pp. 11-13. Illus.

**Saving Money on Shipping Containers. 658.7884**

Assembly work on containers, relative cost of packing, cost of auxiliary equipment, salvage value of containers, convenience to [illegible] MANUFACTURING INDUSTRIES, Feb. 1926, pp. 131-2. Illus.

## Production Control and Material Handling

### Production Control

**Control of Inventory Through the Scientific Determination of Lot Sizes—V. 658.7**

H. S. Owen. The purchase and control of raw materials; ascertaining the quantity on which the rock bottom price is based. *Industrial Management*, Feb. 1926, pp. 117-8.

**Correct Textile Inventorying. 658.787**

Eugene G. Bonelle. Methods of taking, costing and checking inventories of raw material, stock in process, finished goods. *Textile Mercury*, Feb. 6, 1926, pp. 255-6.

**Locomotive Repair Shop Labor Saving Devices. 658.27**

Development of machine equipment, cutting tools and jigs is encouraged at Houston, Texas, shops of the Southern Pacific Lines. *Railway Mechanical Engineer*, Feb. 1926, pp. 109-14. Illus.

**Pennsylvania Rebuilds Steel Freight Cars at Enola. 658.5**

Units progress through the shop past repair gangs. Average daily output is 36 cars. Sixty tons of material are reclaimed in 8 hours. *Railway Mechanical Engineer*, Feb. 1926, pp. 97-102. Illus.

**Saving Money Through Scientific Purchasing. 658.7**

Henry W. Knodel. Formulating a purchas-

ing policy; commodity price movements; seasonal, cyclical and secular trends; purchase of manufactured products price comparisons by direct and indirect methods. *Industrial Management*, Feb. 1926, pp. 70-7. Illus.

**Simplified Production and Handling. 658.5**

H. H. Edge. Conclusion of article commencing in the previous issue and showing how the Kelly Press Division of the American Type Founders Company has saved in manufacturing and handling operations by a broad classification of work into two groups—round and flat—each processed on a separate floor. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 185-8. Illus.

### Production Processes

**Electric Heat in Industry. 658.27**

General Electric Co. Bulletin GEA-261. 32 pp. Illus. Advantages of electric heat for various industrial applications, including the metal industry, heat treating, ceramic industry, chemical industry, printing industry, finishing processes, etc.

**Getting Most Out of Fuel Oil. 658.27**

Max Sklovsky. Study of performance of oil-fired industrial furnaces indicates factors affecting proper combustion and general efficiency. Type of furnace and continuity of operation important considerations. *Iron Trade Review*, Jan. 28, 1926, pp. 271-3. Illus.

**Pulverizes Coal at the Furnace. 658.27**

E. C. Kreutzberg. Kuebler Foundries, Inc., Easton, Pa., prepare powdered fuel near reverberatory furnace with equipment consisting of handling apparatus, dryer and pulverizer. Guaranteed saving is 25 per cent. *Iron Trade Review*, Jan. 28, 1926, pp. 262-3. Illus.

**Works Hydraulic Systems. 658.27**

Points out important features of hydraulic pressure equipment in modern manufacturing plants, with the idea of developing methods to avoid the wasteful operation prevailing. *Power Engineer*, Jan. 1926, pp. 8-13. Illus.

### Material Handling

**New Cost Basis for Material Handling. 658.281**

F. E. Moore, president of Mathews Conveyer Company, shows how a modified form of machine hour rates has been applied to four conveyor systems in his plant with appreciable savings. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 169-70. Illus.

**Electric Industrial Trucks Reduce Costs of Handling Wire and Strip. 658.281**

Harold J. Payne. Advantages of typical installations and savings brought about. *Iron Trade Review*, Jan. 21, 1926, pp. 204-5. Illus.

**Floor Transports in Small Works. 658.281**

C. Weicken. Various kinds of barrows and trucks used in industrial plants for economic handling of materials. *Engineering Progress*, Jan. 1926, pp. 13-16. Illus.

**Labor Saving Methods Reduce Costs for the Oregon Gravel Company. 658.281**

E. D. Roberts. Equipment that enabled the company to more than pay for its cost in one season's operation. *Pit and Quarry*, Jan. 15, 1926, pp. 75-80. Illus.

**Reducing Lumber Handling Costs. 658.281**

New planing mill of the Southern Pacific Railroad at Sacramento has adopted straight-line production methods for the preparation of lumber. MANUFACTURING INDUSTRIES, Feb. 1926, pp. 111-2. Illus.

## Employment and Personnel Management

### Selection and Training

**Shop and Employment Tests for Qualified Welders. 658.31156**

Glenn O. Carter. *Railway Mechanical Engineer*, Jan. 1926, pp. 39-41. Illus.

### Personnel Management

**Employee Acceptance and Its Importance. 658.315**

John F. Sherman. Shows the importance of having any plan of employee relations harmonize with the workers' desires, to meet with success. *Manufacturers' Record*, Feb. 11, 1926, pp. 73-4.

**Management of Men in Industry. 658.3**

J. Seton Gray. Starting a new man right, relieving the monotony of repetition work, keeping the man interested in and proud of his work, keeping promises, leading instead of driving men, fair dealing with and proper promotion of men. *Machinery*, Feb. 1926, pp. 445-7.

### Remuneration

**Group System of Wage Payment—I. 658.32**

Harold B. Maynard and G. J. Stegemerten. System used at the Westinghouse Electric and Mfg. Co. has reduced overhead and unit costs. What the system is, what it accomplishes, and the conditions under which it can be applied. *Industrial Management*, Feb. 1926, pp. 93-8.

### Health and Safety

**Industrial Safety. 658.3823**

Edited by Richard H. Lansburgh. *The Annals of the American Academy of Political and Social Science*, Philadelphia, Jan. 1926. 224 pp. This volume appears just at a time when industrial safety is having increased attention and when numerous attempts are being put forth to arouse the responsible interest of manufacturing officials and executives in the safety situation in their own plants and organizations. Like other issues of "The Annals" the work is a series of monographs presenting a rounded out point of view on industrial safety. This volume should become a part of the working library of everyone who is at all responsible for the conditions of safety in any manufacturing plant.

**Is Safety a Factor in Modern Industry? 658.3823**

Howard Coonley. Accidents represent the largest single waste in industry today. Results of safety work in a few typical organizations. *Safety*. Jan.-Feb., 1926, pp. 31-2.

**Problems and Functions of a Safety Engineer. 658.3823**

Kenneth C. Monroe. Practice of the Bridgeport Brass Co. in regard to the application of safety devices for use of employees. Safety bulletins, methods of securing co-operation of employees to establish safe practices and the accident record. *American Machinist*, Feb. 4, 1926, pp. 197-8. Illus.

**Safety Progress Requires Better Records. 658.3823**

Although remarkable reductions in accident rates have been made, further progress is impeded by the lack of a standard system of keeping records, thus making impossible any comparisons between plants, with consequent improvements in accident prevention methods. A suggestion for developing uniform records. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 211-12.

**Safety Work in the Ford Organization. 658.3823**

R. A. Shaw. Methods by which an 80 per cent reduction in accidents has been brought about. Forty men are engaged in safety inspection work exclusively and every plant has a safety committee which makes periodical inspections. *Safety*, Jan.-Feb. 1926, pp. 17-25. Illus.

## Financial Control and Accounting

### Financial Control

**Analyzing Net Worth in the Financial and Industrial Investigation. 658.14**

Arthur Andersen. Methods of investigating and analyzing net worth in working through the financial and industrial investigation of a manufacturing concern. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 201.

**Summarizing Costs for the Directors. 658.14**

Rudolph Rosenthal. A description with complete tables and charts showing how the cost department of a small factory develops its monthly summary reports for the information of the board of directors. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 179-84. Illus.

**Novel Budgets Cut Indirect Expenses. 658.14**

U. L. Harmon. A novel system of operating budgets developed for the use of manufacturing departments. The result of their operation has been a striking reduction in manufacturing costs. MANUFACTURING INDUSTRIES, Mar. 1926. pp. 189-92.

**Role of Paper Profits in Industry. 658.14**

George E. Putnam. When business conditions are unstable manufacturers should give close attention to the proper and improper use of paper profits. This paper emphasizes that point of view indicating the basis for proper judgments. *Harvard Business Review*, Jan. 1926, pp. 129-37.

**Rudiments of Business Finance. 658.14**

Edward Sherwood Mead and Karl W. H. Scholz. D. Appleton and Co., New York. 307 pp. $2. Written to supply the need for a book on finance which may be clearly understood but at the same time shall contain an adequate discussion of all the important phases of the subject. Takes the stand that more businesses fail because of the lack of intelligent handling of financial affairs than because of lack in almost any other important phases of operation.

Topics elaborated in the text cover: Business enterprise and finance; providing funds to start a new business; advantages and disadvantages of different forms of business organization; organizing a business enterprise; materials of the financial plan of the business corporation—stocks and bonds; marketing securities; providing working capital; determination of business income; distribution of earnings, further management of corporate income; financing of business expansion; governmental regulation of corporate activity; financial failure and the reorganization of business enterprises; the future of the business corporation.

**What Should the Net Profit Be? 658.14**

W. I. Clearhall. Presents the [illegible] profit ideals and ideas of manufacturers and then establishes a basis for estimating and including a proper profit when fixing selling prices. MANUFACTURING INDUSTRIES, Mar. 1926, pp. 175-8.

### Accounting and Cost Finding

**Brush Manufacturing Costs. 657.452**

Norman H. Broadhead. Methods for ascertaining costs in the brush manufacturing industry. *National Association of Cost Accountants Bulletin*, Jan. 15, 1926, pp. 365-76. Illus.

**Cost Accounting as Aid to Factory Production and Executive Control. 658.14**

John Craig. What factory manager should be able to do with information furnished by the cost accountant. *Canadian Manufacturer*, Dec. 1925, pp. 15-17.

**Inventory Accounts and the General Accountant. 657.37**

Arphaxad Foy. *National Association of Cost Accountants Bulletin*, Feb. 1, 1926, pp. 409-16.

**Use of Scheduled Costs in Paper Mills. 657.452**

Harry D. Anderson. Discussion of standard or schedule for conversion costs based on the standard output per year. *Paper Trade Journal*, Jan. 21, 1925, pp. 55-8.

## Miscellaneous

### Economics

**Income in the Various States. 33**

Maurice Leven. National Bureau of Economic Research, Inc., New York. 306 pp. $5. Sources and distribution of income in 1919, 1920 and 1921, based upon estimates of the national totals by Willford I. King. Covers many fields of economic importance—manufacturers; mines, quarries and oil wells; agriculture; construction. Compares wages and salaries in these various fields. Discusses wages and salaries in trade, transportation and miscellaneous industries; agricultural receipts and expenses; distribution of agricultural income; entrepreneurial and property income; miscellaneous incomes; summary and analysis of distribution of total net income. Extensive charts and tables are included.

**Studies in Public Finance. 336**

Edwin R. A. Seligman. Macmillan Co., New York. 302 pp. $3.25. Material originating during the last 10 years, and consisting of articles in periodicals, chapters from books jointly edited, public addresses, association reports and hearings before legislative committees. Chapter headings are: Comparative tax burdens in the twentieth century; the Allied debts; income taxes and the price level; taxation and prices; are stock dividends income?; the sales tax; tax-exempt securities; death taxes; taxation of non-residents in the New York income tax; fiscal reconstruction; reform of municipal taxation.

**Wages and Hours of Labor. 331.2:674**

Digest of wages and hours of labor for woodworkers in various countries. *Monthly Labor Review*, Jan. 1926, pp. 113-20.

### General

**Directory of Iron and Steel Plants and Allied Industries, 1925. 338**

The Andresen Co., Pittsburgh. 358 pp. A most exhaustive list of companies and officials operating blast furnaces, steel plants, rolling mills, structural steel shops, railroad shops, forging, heat treating and stamping plants, and by-product coke plants. It is an annual publication giving the names of the responsible officers and executives, and statistical matter indicating the nature of the products and size of plant or volume of output.

**Engineering Achievements of the Westinghouse Electric and Manufacturing Company for the Year 1925. 621**

H. W. Cope. Westinghouse Electric and Mfg. Co. Pamphlet, 43 pp. Illus.

## New Industrial Equipment

**Air Economizers. 621.183**

Used in preheating air for combustion, process work, heating factories, drying, incinerator work, and for use in connection with very wet fuel. Air and gas flow counter to each other, separated by plates set close enough to allow particles to get no further than ¾ in. away from a heating surface. Velocity of both is about the same, and high enough to insure maximum heat transfer at minimum power expenditure in fan.

Plates are reversible so that their life may be practically doubled by turning the corroded cold end around to occupy the hot end position, where little corrosion occurs. Unit chambers are assembled in sections and enclosed in a well-insulated casing. They can be replaced without disconnecting economizer from the flue. Cleaned by wire brushes or soot blowers. Made by B. F. Sturtevant Co.

**Baffle Wall for Boilers. 621.1845**

To provide a simple, flexible, gas-tight, durable and inexpensive baffle wall, the Boiler Engineering Co. have put on the market a type consisting of a plastic refractory material in which corrugated sheet metal is imbedded to form joints between the rows of tubes. This eliminates splitting and spalling off of the wall, prevents breaks and leaks, allows tubes to be replaced without disturbing the baffle, and relieves brick work of strains. The baffle can be placed at any angle in any water tube boiler, and gives a lower stack temperature, proper draft drop, greater boiler capacity and freedom from excessive slag and soot trouble.

**Bending Roll. 621.982**

Built by Buffalo Forge Co. and known as the Buffalo No. 1 horizontal bending roll. Rolls arranged vertically so that the material worked on is in a horizontal plane. Regularly used for flat bars, but by using additional rolls it is possible to bend angles, tees, squares, round or twisted bars, 12 or 16 gage copper tubes, standard, heavy and extra heavy steel pipe, I-beams and channels. Adjustment of rolls, made by one man, is only 1¾ in. to handle work from 13½ in. diam. circles made of 2 by ⅜ [illegible] wise, up to any diameter. Mounted on cast iron base at bottom of pit to bring platform 10 in. and rolls 36 in. above floor line. Concealed gearing. Driven by 10 hp. General Electric reversing motor.

**Magnetic Switches for A. C. Motors. 621.34**

The General Electric Co. have commenced manufacture of enclosed magnetic switches for the operation of alternating-current motors. They have characteristics of ease of inspection and renewal of vital parts, overload protection and long life of contacts. Type CR7005-A4 is intended for small motors having maximum capacity of 3 hp., 110 [illegible] volts. CR7006-D7 and D9 have horsepower [illegible]

**Oil Motor Starter. 621.34**

Features of the new oil motor starter manufactured by [illegible] Electric Mfg. Corp. are compactness, ease of installation, controlled from any number of points, knockout for conduit connections, overload and undervoltage protection, three [illegible] shipper rod or rope operation. It is supplied either with or without fuse clips. Equipped with thermal relays it offers an economical means of obtaining overload time-lag protection for motors. Operates under 30 amperes or less and 600 volts A. C. or less.

# News of Manufacturing Industries

## The Month in Brief

**Alexander Smith & Sons Carpet Works.**—About 7000 employees participated in the 30th semi-annual bonus awarded by this company for faithful service. The total was about $450,000, making a grand total of about $6,000,000 distributed since the plan was inaugurated by Alexander Smith Cochran, principal owner of the mills, in 1911.

**Allis Chalmers Manufacturing Company** reports for 11 months ending Nov. 30, 1925, net profit of $2,994,129 after Federal taxes. Profit and loss surplus on Nov. 30, 1925, totaled $14,511,326, comparing with $13,542,986 on Jan. 1, 1925.

**American Brown Boveri Electric Corporation** has acquired the Railway and Industrial Engineering Company of Greensburg, Pa., and the Electric Development & Machine Company, of Holmesburg, Pa. These acquisitions have an annual sales volume of about $2,000,000.

**American La France Fire Engine Company** for the ten months ended Oct. 31, 1925, reports net profits of $580,734 after charges and reserves for taxes.

**Jones & Laughlin Steel Corporation.**—The directors have declared an initial dividend of $1 per share on the outstanding 573,320 shares of common stock, par $100, payable March 1, and the regular quarterly dividend of 1¾ per cent on the preferred stock, payable April 1 to holders of record March 15.

| *Calendar Years* | 1925 | 1924 | 1923 |
|---|---|---|---|
| * Net income | $9,854,494 | $8,194,384 | $10,303,528 |

* After all charges and reserve for depreciation, depletion and taxes.

**American Rayon Products Corporation** reports earnings for the nine months ended Dec. 31 of $263,167, equivalent to approximately $2.40 a share on the 110,000 shares outstanding.

**Atlas Powder Company.**—The company's report for the year ended Dec. 31, shows total sales of $20,588,981, compared with $19,462,295 for 1924, an increase of 5.8 per cent. Net income, after allowing for all charges, including interest and taxes, was $2,130,535, a return of 7.53 per cent on total assets, and after payment of 6 per cent dividends on preferred stock was equivalent to $6.08 a share on the 261,438 shares of no-par-value common.

**Barrett-Cravens Company** has purchased the building at 30th Street and Spaulding Avenue, Chicago, containing 73,000 sq. ft. of floor area to accommodate the growing business of the firm.

**Bethlehem Steel Corporation** is offering its 7 per cent cumulative preferred stock to employees under the Employees Saving and Stock Ownership Plan. The price is $101 per share. Employees are permitted to pay for the stock in instalments deducted from wages at the rate of $4 per share per month. Up to this time $3,500,000 par value of the stock has been paid for in full by employees and certificates issued. As an incentive to hold the stock each employee receives special payments for five years upon stock purchased and held. These payments are $1 per share for the first year, $2 for the second, $3 for the third, $4 for the fourth, and $5 for the fifth, making a total of $15 per share for the five years.

**Brown & Bigelow.**—Effective Feb. 1, the Ingersoll Redipoint Company, Inc., was consolidated with Brown & Bigelow, giving a manufacturing organization of about 2000 employees. The production facilities will be increased by the addition of 126,000 sq. ft. of floor area and a modern power plant. The consolidation produces the largest concern in the world manufacturing pens and pencils.

**Carnegie Steel Company.**—The Edgar Thomson Works of the Carnegie Steel Company reports a record of 414,000 man days without accidental injury.

**Chandler Motor Car Company.**—A plan for the consolidation of this company with the Cleveland Automobile Company has been declared effective.

**Clark Thread Company,** employing about 5000 workers, reports 268 consecutive days without accidental injury. This is equivalent to about 1,300,000 man days.

**Columbia Steel Company** declared a stock dividend of 100 per cent in common stock on both preferred and common stocks payable Feb. 10, 1926.

**Continental Baking Corporation.**—M. R. Lott, former personnel superintendent of the Sperry Gyroscope Company, on Feb. 1 took up the duties of personnel director with the Continental Baking Corporation.

**Corn Products Company.**—Net earnings of Corn Products Company for 1925 may amount to somewhere around $2.50 a share on the 2,530,000 shares of $25 par value common stock.

**Crane Company.**—Stockholders have increased authorized capital stock from $65,000,000 to $90,000,000.

**Curtiss Aeroplane & Motor Company, Inc.**—The directors have declared a divident of 3½ per cent on the preferred stock, payable March 1. This is the same amount as that paid in March 1925. In Sept. 1925 a dividend of 2½ per cent on the preferred was paid.

**Deere & Company.**—The directors have declared a regular quarterly dividend of 1¾ per cent on the preferred stock, together with an extra dividend of ½ of 1 per cent on account of accruals, both payable March 1. An extra distribution of ¼ of 1 per cent on account of accumulation was made on the preferred stock on Dec. 1 last.

**Dodge Bros. Inc.**—Retail sales in the four weeks ending Jan. 30, totaled 19,218 cars, new car deliveries, 14,943. Factory shipments of cars and trucks were 22,135. This is an increase of 41 per cent over Jan. 1925.

**E. I. DuPont DeNemours Company.**—The fuze works of the duPont Company reports a safety record of 381,000 man days, during a period of seven years with only one time-losing accident. This single accident cost but $18.

**Electric Refrigerator Corporation.**—Official announcement has been made that the plan of consolidation of the Kelvinator Corporation, Nizer Corporation and Grand Rapids Refrigeration Corporation has become effective. The capacity of the consolidated corporation will be in excess of 500 refrigerators per day, based on normal-sized units, and 1000 ice boxes.

**Ford Motor Company** made available profit-sharing certificates for its employees on Feb. 1. The issue of these certificates was temporarily discontinued April 1, 1925, when the quota of $25,000,000 was reached. Each employee is permitted to deposit from his pay check an amount not exceeding one-fourth of his total pay. When $100 has accrued the employee receives a certificate guaranteeing the holder 6 per cent on the investment.

**Gabriel Snubber Manufacturing Company.**—Earnings for the past four years are reported as follows:

| Years ended Dec. 31 | 1925 | 1924 | 1923 | 1922 |
|---|---|---|---|---|
| Net earnings after charges and Federal taxes | $1,314,082 | $1,086,195 | $1,237,594 | $1,161,751 |

Balance sheet as of Dec. 31, 1925, shows

*(Continued on page 220)*

"We never know how *little* we make (or save) until we know how *much* we WASTE"

# Helping You Eliminate Waste!

Our business is that of collaborating with industrial executives in determining, diagnosing, evaluating and eliminating waste, and the following is a resume of the essential factors in our plan for practically serving industry in this field.

| | | |
|---|---|---|
| 1. | **Principle** | That of engineer, scientist and economist, cooperating to eliminate waste, with employer and worker. |
| 2. | **Plan of Rewards** | A fair share of the savings made will go to employees who help to effect them, and a retainer plus a fair share of the savings will be paid us, *the major portion being retained by the client.* |
| 3. | **Control Mechanism** | Efficient methods have been devised for currently recording all pertinent data in connection with specific Waste Elimination work, so that statements can be made covering what savings are, where made, and those helping make them, thus avoiding the controversies which usually go with contingent work. |
| 4. | **Waste Covered** | Man-power waste (time losses) and waste in resources (material, equipment, product). |
| 5. | **Scope of Work** | From raw material operations, through fabrication and distribution, to ultimate use of products by consumers. |
| 6. | **What We Do** | We survey and evaluate, make researches, standardize and simplify, and supervise and counsel. |
| 7. | **Elements Covered** | Products, plant, equipment, operations, and materials. |
| 8. | **Research** | We maintain a well-equipped and properly manned research laboratory, where both chemical and physical experiments, tests and developments are carried on. |
| 9. | **Essential Features** | Our approach to a problem is not theoretical, nor do we go into definite Waste Elimination work which cannot be evaluated as to kind and extent of waste, methods needed for eliminating it, and extent of probable savings. |
| 10. | **Joint Staff Activity** | We ccoperate in every possible way with client's organization, making it a "joint staff" activity, in which the outside and extensive viewpoint and the inside and intensive experience, are focussed to a common end—Waste Elimination. |
| 11. | **Financial Aspect** | We strive to recommend betterments which involve a minimum of capital outlay, and which will return their cost quickly. |
| 12. | **Assay Plan** | In determining the field for our work, we make an assay (not a survey), for which we receive only expenses of traveling and living if we fail to demonstrate (1) that there are preventable wastes and (2) that they should be eliminated. If we do so demonstrate, we receive a fee, one-half of which would be rebated should our regular service subsequently be arranged for. |

Correspondence is invited from industrial executives interested in this great subject of Waste Elimination, and the submission of pressing problems will be appreciated, all of which will be held in the strictest confidence.

## WASTE ELIMINATORS

INCORPORATED

C. E. KNOEPPEL, *Managing Director*

PARK SQUARE BUILDING BOSTON, MASSACHUSETTS

*Division of Bigelow, Kent, Willard & Co., Inc.*

# Conserve Production Energy

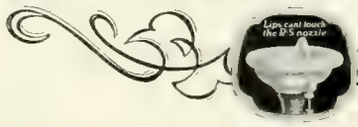
This is certain—Rundle-Spence Vertico-Slant Fountains will *conserve production energy* in your factory. Remember these facts—Drinking becomes quicker and easier. The slight slant stream is convenient, handy and germ-proof. Your employees will take "less time out" and put "more work in." The profit is seen in production.

The R-S line includes Sanitary Drinking Fountains, Bath and Plumbing Fixtures and Supplies. Write for illustrated catalog with complete information.

**RUNDLE-SPENCE MFG. CO.**

62 Fourth Street Milwaukee, Wis.

RUNDLE-SPENCE



## Superheated Steam Helps Make This Power Plant the Most Economical in Mississippi

By installing Elesco superheaters in its three 150-hp. Walsh and Weidner return tubular boilers, the Water, Light and Power Company of Aberdeen, Mississippi, has been permitted to operate on one less boiler than would be necessary on saturated steam, and the net operating cost has been materially reduced.

It is generally more important to superheat the steam in a small plant than in a large one, because the percentage of saving is greater.

THE SUPERHEATER COMPANY

17 East 42nd Street NEW YORK — Peoples Gas Building CHICAGO

Boston — Pittsburgh

Canada: The Superheater Company, Limited, Montreal


current assets of $1,582,807 (including $800,000 U. S. Liberty bonds) and current liabilities of $309,089.

**General Electric Company.**—Supplementary compensation, amounting to $1,367,426.07, was paid in February to 30,318 employees of its plants and offices who have been with the company for five years or more. The sum paid each individual represents five per cent of his earnings for the six months ending Dec. 31, 1925. Payments were made in G-E Employees' Securities Corporation bonds or cash as the employee desired. The amounts paid to the employees of the various works and offices of the company were as follows:

| | |
|---|---|
| Schenectady Works | $ 480,554.84 |
| Lynn—River Works | 186,205.99 |
| Lynn—West Lynn Works | 67,299.12 |
| Pittsfield Works | 119,416.15 |
| Erie Works | 73,827.60 |
| Fort Wayne Works | 76,230.86 |
| Edison Lamp Works | 60,142.62 |
| National Lamp Works | 86,092.67 |
| General Office | 64,318.16 |
| District Offices | 94,283.06 |
| All other Works and Departments | 59,055.00 |
| Total | $1,367,426.07 |

**General Fireproofing Company.**—The directors have declared a dividend of one share of Truscon Steel Company common stock for each five shares of General Fireproofing Company common stock held, payable Feb. 10. The Truscon Steel Company stock being distributed was received as part payment for the metal lath business of the company, which was sold about a year ago. Net profits of the General Fireproofing Company after all charges, but before Federal charges for the year ended Dec. 31, 1925, amounted to $1,168,141. Actual manufacturing profit (not including profit from sale of part of business) was $863,103.

**B. F. Goodrich Company.**—The directors on Jan. 27, 1926, issued the following statement: Net sales for the fiscal year ended Dec. 31, 1925, were in excess of $136,000,000. The net profits from operations for that period after deducting ample depreciation on properties, interest on borrowed money, and $2,350,000 for Federal income taxes, were approximately $16,700,000. From these net operating profits the company has set aside an additional reserve of $4,000,000 for contingencies and to cover possible losses due to fluctuation in price of raw materials.

Comparative net sales by calendar years:

| 1925 (Est.) | 1924 | 1923 |
|---|---|---|
| $136,000,000 | $109,817,685 | $107,092,730 |
| **1922** | **1921** | |
| $93,649,710 | $86,687,339 | |

**Goodyear Tire and Rubber Company.**—Net sales of the Goodyear Tire and Rubber Company, after allowing discounts and other deductions, and net profits for the year 1925 established a new high record for the company, both before and since the reorganization in 1921. The year's net business aggregated $169,470,112, against $115,323,173, exclusive of the returns of subsidiary organizations in Western terri-

*(Continued on page 223)*

# Construction and Equipment *for* The Modern Plant

THE record industrial construction predicted for 1926 showed unmistakably during January. Contracts awarded in 37 states totaled $94,676,500 according to the F. W. Dodge Corporation's Review. The necessity of modern buildings and equipment in these days of keen competition is emphatically reflected in this huge volume of projected new construction. Only the most improved and efficient means of production can hope to turn out products at a cost to earn a profit in these times of high material prices and wage rates.

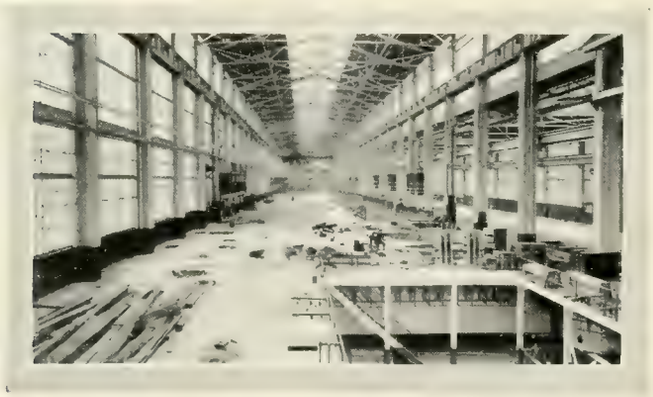
The materials, construction and equipment indexed below and advertised in the following pages are being installed in modern manufacturing plants which are striving for improved operation and lower costs.


| | PAGE |
|---|---|
| Buildings | |
| Stone & Webster | 222 |
| Copper and Brass | |
| Copper and Brass Research Ass'n | 227 |
| Glass, Wired | |
| Mississippi Wire Glass Company | 224 |
| Grinding Machines | |
| Norton Company | 240 |
| Hangers, Shaft | |
| Skayef Ball Bearing Company | 239 |
| Instruments, Recording | |
| Taylor Instrument Company | 229 |
| Motors, Electric | |
| General Electric Company | 230, 231 |
| Westinghouse Electric & Manufacturing Co. | 237 |
| Scales | |
| Merrick Scale Manufacturing Co. | 226 |
| Time Recorders | |
| Calculagraph Company | 225 |
| Trucks, Industrial | |
| Marion Tool Works | 228 |
| Mercury Manufacturing Co. | 223 |
| Steubing-Cowan Company | 234-235 |
| Valves | |
| Jenkins Brothers | 224 |
| Ventilating and Power Equipment | |
| Buffalo Forge Company | 227 |
| Wire Binding | |
| Gerrard Wire Tying Machines Co. | 233 |

# WORKING FOR WESTINGHOUSE

STONE & WEBSTER work for Westinghouse has been practically continuous for many years. Important manufacturing units as well as additions to boiler and power plants have been built at Trenton, Milwaukee, Bloomfield, N. J., Belleville, N. J., Sharon, Pennsylvania. This succession of Westinghouse contracts indicates their complete satisfaction in our service.

*We work with you and for you.*



# STONE & WEBSTER
INCORPORATED
# BUILDERS

NEW YORK, 120 Broadway
PHILADELPHIA, Real Estate Trust Bldg.
BOSTON, 147 Milk Street
SAN FRANCISCO, Holbrook Bldg.
CHICAGO, First National Bank Bldg.
PITTSBURGH, Union Trust Bldg.

[illegible] before deductions for charges, the company reported earnings of $26,284,672, against $17,363,162 in 1924, while after interest charges, net profit for 1925 was $21,-005,898, against $12,161,540. After appropriating $7,500,000 as a special [illegible] terial reserve, the net earnings available [illegible] against $12,161,540 in 1924. The company paid out $5,655,156 in dividends last year, and the profit and loss surplus on Dec. 31 amounted to $30,649,319, against $22,798,576.

The consolidated balance sheet at the close of 1925 showed current assets of $68,-291,272, including $15,750,059 cash, $38,-058,423 inventory and $14,482,790 accounts receivable, less reserves. Current liabilities aggregated $10,582,652, the ratio of assets to liabilities being 6.5 to 1.

**H. W. Gossard & Company.**—The annual statement of income of H. W. Gossard & Company for calendar year 1925 shows net, $479,756, equal to $5.76 a share after preferred dividends on the common stock. This contrasts with $3.38 a share in 1924. Net sales aggregated $5,216,280 and surplus for year after dividend payments was $201,232 against $78,364 in 1924. Current assets as of Dec. 31, 1925, amounted to $2,965,342; current liabilities, $754,945.

**Hamilton-Brown Shoe Company.**—Balance sheet as of Dec. 31, 1925:

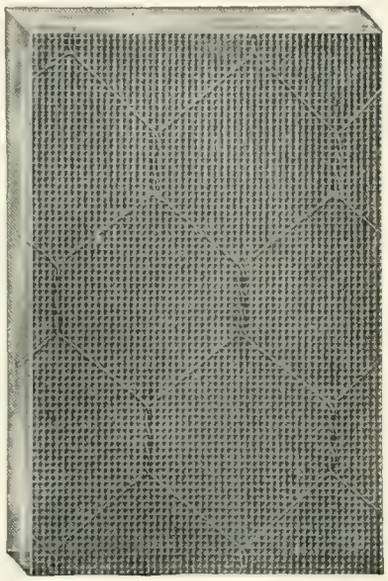
| | | |
|---|---|---|
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |
| [illegible] | [illegible] | [illegible] |

# Factrolite Wire Glass

For windows, this is the best type of glass to install.

Because it is scientifically designed especially for windows to eliminate the glare of the sun and afford uniform light distribution.

By using Factrolite it is possible to increase the light in a room 25 feet or more deep from 38 to 72 per cent as compared with clear glass.



*Made in both Plain and Wire Glass*

**MISSISSIPPI GLASS COMPANY**
**MISSISSIPPI WIRE GLASS COMPANY**

220 Fifth Avenue
**Chicago, Illinois** **New York** **St. Louis, Missouri**



# Valves that "speed up" work

Guard against delays and inconveniences by installing Jenkins Rapid Action Valves. In hundreds of installations these fast workers are living up to their name, and making good in operations where rapid flow is required and a valve must be opened and closed many times.

A short pull of the lever provides an instantaneous full flow. The valve stays open automatically, and closes quickly without shock or water-hammer—due to special piston and air chamber construction. A Jenkins Renewable Disc insures leakproof contact on the seat.

Obtainable through your supply house.

*JENKINS BROS.*

*80 White Street* ..... *New York, N. Y.*
*524 Atlantic Avenue* ..... *Boston, Mass.*
*133 No. Seventh Street* ..... *Philadelphia, Pa.*
*646 Washington Boulevard* ..... *Chicago, Ill.*

*JENKINS BROS., Limited*
*Montreal, Canada* *London, England*

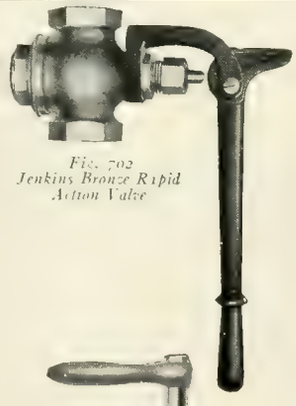


*Fig. 702 Jenkins Bronze Rapid Action Valve*

*Fig. 241 Jenkins Bronze Quick-Opening Valve*

Always marked with the "Diamond"
**Jenkins Valves**
SINCE 1864


**Hayes Wheel Company.**—Directors of the Hayes Wheel announced an extra dividend of 25 cents a share in addition to the regular quarterly payment of 75 cents. The regular payment of $1.87½ on the preferred also was authorized.

**Ingersoll Rand Co.**—The directors on January 20 declared a quarterly dividend of 75 cents per share on the new common stock, of no par value, payable March 1. This places the stock on a $3 annual dividend basis which is equivalent to $12 per share per annum on the old common stock, par $100, which was recently issued in exchange for new no par common stock on the basis of four new for one old. Dividends paid on the old common stock were at the rate of $8 per annum.

**Inland Steel Company.**—The company's operating income last year was slightly larger than for 1924, but diminution of other income caused a smaller net, the figures being $7,980,316 net for 1925 against $8,044,563 previous year. Net earnings after interest, taxes, etc., amounted to $4,869,734 against $5,474,601 in 1924, equal to $3.52 a share on 1,182,799 shares of common stock outstanding. After payment of dividends on the preferred and common, the earned surplus for the year was $1,212,736, bringing total surplus to $19,830,232 as of Dec. 31, 1925. Following is the condensed income statement for years ended Dec. 31:

| | 1925 | 1924 |
|---|---|---|
| Total income | $7,980,306 | $8,044,563 |
| Net after taxes, etc. | 4,869,734 | 5,474,601 |
| Preferred dividends | 700,000 | 700,000 |
| Common dividends | 2,956,988 | 2,956,988 |
| Surplus for year | 1,212,736 | 1,817,603 |

Total surplus as of Dec. 31, 1925, amounted to $19,830,232 against $18,617,496 on Dec. 31, 1924.

**Intercontinental Rubber Company.**—Announcement is made that the company is now preparing to make its first transplanting on 200 acres of selected land in California of guayule shrub seedlings, from which plant rubber is made. It is the aim of the company to promote production of rubber in America through development of guayule cultivation in sections of the United States, where climate conditions are favorable. Seed beds will be prepared this year for planting additional acreage in 1927. This company, which has long been producing rubber profitably in Sumatra and Mexico, is said to be the only public or private agency which has developed a concrete plan and program for rubber production on a large scale in the United States. The guayule shrub which the company proposes to cultivate is stated to be the only plant bearing rubber in commercial quantities capable of withstanding frost, a necessary characteristic for its successful exploitation in this country.

**International Harvester Company** has acquired valuable timber, water power sites and pulp wood properties in British Columbia. The purchase prices is stated as approximately $6,000,000.

*(Continued on page 226)*

# Exact *Elapsed Time* Records

## Are Essential to Economy in Production

Your records of *elapsed time* must be accurate, legible and unalterable—if you expect to make them play their true part in the economical management of your production.

Old-fashioned methods leave too much room for error—error through negligence, and sometimes error "with intent."

Calculagraph Elapsed Time Records fit any cost system without the necessity of readjustment. They give absolute protection to your cost accounting.

Elapsed time—the exact *difference between* the beginning and ending of every job—is computed automatically by Calculagraph. It prints *on the time ticket* the beginning, ending and precise *time elapsed* on every job—and prints all this accurately, legibly and unalterably—for any number of workmen. This machine is a simple, portable unit—not an expensive "system." Calculagraph can be conveniently placed anywhere in shop or office.

We issue a comprehensive booklet—*Elapsed Time Records*—containing interesting data on elapsed time in its relation to management, production and accounting. Send for it today.

**The Calculagraph Company**

**50 Church Street Dept. 12 New York City**

CALCULAGRAPH

*The Elapsed Time Recorder*

SAVE TIME AND LABOR

USE THE

# Merrick Conveyor Weightometer

Any material handled on a belt, bucket or pan conveyor fitted with **MERRICK WEIGHTOMETER** is automatically weighed as it moves along. The scale is always on the job—it makes no slips—it's honest—and its totals at the end of the day are accurate and they require no special attendant.

TYPICAL INSTALLATION

*Material being handled over Weightometers*

| | |
|---|---|
| COAL | FERTILIZER |
| ORES (all kinds) | PHOSPHATES |
| CEMENT | SAND |
| SHALE | PAPER MILL PRODUCTS |
| CLINKER | |
| ROCK | HOG FUEL |
| GYPSUM | SALT |
| FISH | ETC., ETC. |

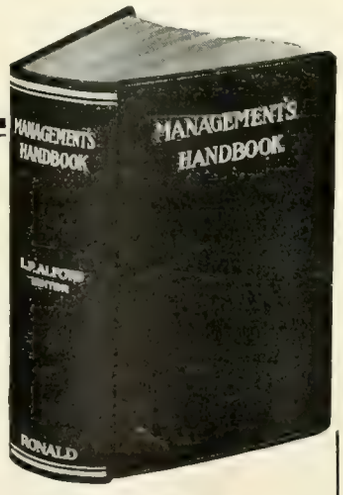
MERRICK SCALE MANUFACTURING CO.

186 AUTUMN STREET, PASSAIC, NEW JERSEY



*The Great Reference Book for Manufacturers*

# Management's Handbook




THIS Handbook is saving to thousands of active managers, both here and in foreign countries, many hours they would otherwise spend in research and investigation. Its 1607 pages bring together in organized form the best up-to-date experience on every phase of control in all departments of a manufacturing company.

***Production - Finance - Marketing***

Whether your business is large or small, and whether your personal responsibility is production, finance, marketing, or any of the related operations, you will find in this Handbook reliable answers to hundreds of questions arising in connection with your work.

***L. P. Alford, Editor - 34 Contributors***

Mr. Alford's familiarity with the field gives him an unequalled background for editing this book. Associated with him in this work were 34 able specialists, each an acknowledged authority in the field he covered. The material presented summarizes the best practice of a wide range of companies which have developed unusually profitable methods.

650 illustrations 290 tables Exhaustively indexed Flexible binding *1607 pages* $7.50

**32 Complete Sections**

Organization for Operation—Production Control—Management Ratios—Maintenance of Labor—Budgetary Control Office Management—Classification and Symbols—Tool Storage and Issue Quality Control Cost and Profit Variation Formulas.

Material Handling—Market Analysis—Wage Payments and Time-keeping—Mathematics of Management Graphic Methods—Plant Layout—Purchasing and Stores-keeping Rate-setting Plant Maintenance Salvaging Materials—Shipping and Traffic.

Cost Accounting—Banking Relations Simplification and Standardization—Packing for Shipment—Tables and Statistics—The Industrial Plant Forms Economic Principles—Organization of Ownership Information Filing System—Insurance

**The Ronald Press Company, Publishers**

Dept. 65, 15 East 26th Street, New York, N. Y.


**Moore Drop Forging Company** balance sheet as of Oct. 31, 1925:

| | |
|---|---|
| *Assets* | |
| Cash | $ 381,727 |
| Cash surrender value of life insurance | 206,316 |
| Accounts receivable—trade | 447,168 |
| Notes receivable—trade | 1,000 |
| Inventories | 935,734 |
| Prepaid exp. and accr. income | 25,784 |
| Notes and accounts receivable—of empl. | 6,074 |
| Plants and equipment | 2,590,325 |
| Deferred charge | 20,000 |
| Goodwill, trademarks, etc. | 1 |
| Treasury stock | 116,771 |
| Total | $4,730,900 |
| *Liabilities* | |
| Accounts payable | $ 152,250 |
| Accrued expenses | 76,573 |
| Sinking fund requirements for Jan. 1, 1926 | 86,200 |
| Res. for Federal taxes | 95,000 |
| Res. for undeter. liabilities | 200,000 |
| Net worth | [1] 4,120,877 |
| Total | $4,730,900 |

[1] Represented by 53,959 Class A shares, 55,000 Class B Common shares.

**Naumkeag Steam Cotton Company.**—The annual statement of production and sales for the past 10 years follows:

| *Years November 30* | *Production Yards* | *Sales Yards* | *Receipts from Sales* |
|---|---|---|---|
| 1924–25 | 22,373,893 | 22,650,216 | $9,056,448 |
| 1923–24 | 22,115,941 | 21,660,499 | 8,725,837 |
| 1922–23 | 21,705,784 | 22,474,026 | 9,112,872 |
| 1921–22 | 21,461,236 | 22,566,142 | 8,282,612 |
| 1920–21 | 20,535,237 | 20,718,771 | 7,091,476 |
| 1919–20 | 18,252,527 | 18,379,083 | 9,360,384 |
| 1918–19 | 15,955,473 | 17,315,933 | 6,503,226 |
| 1917–18 | 19,453,269 | 19,363,376 | 7,057,470 |
| 1916–17 | 19,327,464 | 19,285,524 | 4,835,015 |
| 1915–16 | 17,397,586 | 16,139,296 | 3,298,174 |

**Okonite Company.**—William K. Vanderpoel has resigned as general superintendent of distribution of the electric department of the Public Service Electric & Gas Company to become vice-president and executive engineer of the Okonite Company and the Okonite-Callender Cable Company, Inc., manufacturers of wire and cable with factories at Paterson and Passaic, N. J.

**Phillips-Jones Company.**—Arrangements are under way to move a part of the plant of the Phillips-Jones Company from New York City to Pawtucket, R. I. Manufacturing space of 140,000 sq. ft. has been acquired in the River Street plant formerly occupied by D. Goff & Sons, Inc. The new plant will open with about 500 employees and within four months is expected to have on its payroll from 800 to 1000 workers.

**Pittsburgh Plate Glass Company.**—The directors have declared an extra dividend of 5 per cent, payable Feb. 15, and the usual quarterly dividend of 2 per cent, payable April 1. An extra dividend of like amount was paid Feb. 16, 1925, and on Oct. 1, 1925.

**Radio Corporation of America** reported a gross income of $50,405,144 for 1925. Net income after deducting expenses, depreciation and cost of sales and adding other income was $5,737,206. Surplus after reserves for patent amortization, taxes, etc., was $2,852,993. After addition of a previous surplus of $5,000,569 and deduction of $1,500,000 written off goodwill, total surplus was $6,353,563.

*(Continued on page 228)*

**Less money for maintenance**

Spending a little more to put in BRASS pipe eliminates the trouble and expense caused by rusting of corrodible pipe.

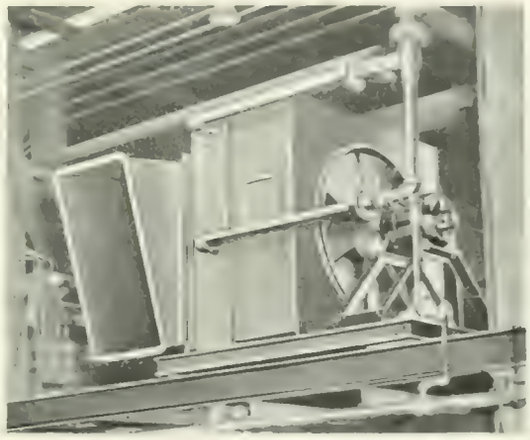
Labor costs for installing corrodible sheet metal are the same as for COPPER work—

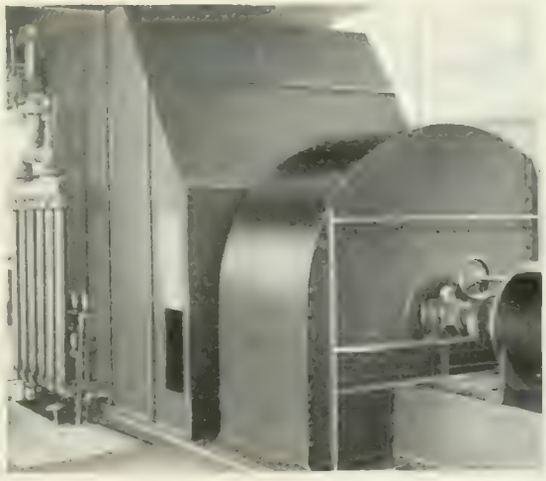
But COPPER ventilators, skylight frames, gutters and downspouts do not have to be replaced.

COPPER and BRASS minimize maintenance costs because they *do not rust.*

COPPER & BRASS
RESEARCH ASSOCIATION
25 Broadway, New York

Use "Buffalo" equipment on every job





"Buffalo" has a complete line of heating and ventilating apparatus, it's priced right, and users testify to its quality.

On this page we illustrate a Buffalo "Breezo-Fin" Unit Heater, one of the lightest, strongest, lowest priced and most effective unit heaters on the market. We also make direct-fired heaters for burning shavings, refuse, etc., as well as "Vento" and pipe coil units.

For factory heating under certain conditions, we build the "central fan" type of heating equipment shown in the second picture. This includes fan and steam-heating coils.

For the very finest types of buildings there is no method of heating and ventilating that compares in reliability, simplicity, effectiveness and ultimate low cost with the "Buffalo-Carrier" method (lower cut) of supplying washed and tempered air, noiselessly, continuously and positively to any or all parts of the building.

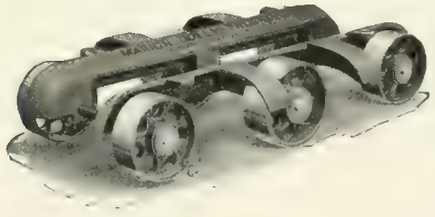
The full story of Buffalo equipment will be sent on request.

**Buffalo Forge Company**
141 MORTIMER STREET BUFFALO, NEW YORK
IN CANADA: CANADIAN BLOWER & FORGE CO., Ltd. KITCHENER, ONT.

heating-ventilating

MARION
Dolly Trucks

YOU can move the heaviest rolls easily, safely and quickly! Marion Dolly Trucks cost no more than ordinary Dollys, but embody many new and exclusive advantages. Built low and with sloping skids; easy to load and unload; frame curved to hold rolls of paper and barrels firmly in place. Will turn in their own length; will handle up to 2½ tons right along. Simple and light enough to be carried anywhere needed, yet durable and practically indestructible. Made of steel and Marion certified malleable.



Marion Dollys "stay put" while being loaded; won't crawl away from you. Heavy rolls can be loaded or unloaded without jarring, tearing or bursting.

*Your savings in stock and manpower will make it cheaper for you to own Marion Dollys than to try to skimp along without them. Write today for complete information prices and special 10-day trial offer No. 88.*

MARION TOOL WORKS, Inc.
Marion - - - - Indiana

**R. J. Reynolds Tobacco Company.**—The Reynolds Tobacco Company balance sheet to Dec. 31, 1925, shows:

| *Assets* | 1925 | 1924 |
|---|---|---|
| Real estate, buildings, machinery, etc. | $ 18,374,268 | $ 17,672,834 |
| Cash | 8,024,866 | 22,024,378 |
| Accounts receivable | 12,545,466 | 13,019,625 |
| Leaf tob., supplies, mfd. prod., etc. | 97,168,844 | 85,726,035 |
| Inv. in non-competitive companies | 962,288 | 4,147,850 |
| Other accts. and notes receivable | 1,137,684 | 1,483,528 |
| Goodwill, pat., etc. | 1,317,891 | 1,319,091 |
| Prepd. int., ins., etc. | 464,385 | 590,913 |
| Total | $139,995,693 | $145,984,256 |
| *Liabilities* | 1925 | 1924 |
| Pf. stk. 7% cum. | $ | $ 20,000,000 |
| Common stock | 10,000,000 | 10,000,000 |
| New Class B Common stock | 70,000,000 | 70,000,000 |
| Accounts payable | 6,442,397 | 4,063,011 |
| Accrued interest, taxes, etc. | 5,297,345 | 4,541,511 |
| Reserve for deprec. and contingencies | 9,101,557 | 7,646,919 |
| Undiv. prof. (after deduction of div. payable Jan. 1) | 39,154,394 | 29,732,814 |
| Total | $139,995,693 | $145,984,256 |

**Royal Worcester Corset Company.**—Control of the company has changed hands with the sale by David Hale Fanning, president and founder, of his 12,006 shares of the company's outstanding 24,000 shares to a syndicate of Worcester business men. According to terms of the sale, the purchased stock will be held in a voting trust for five years to be administered by Aldus C. Higgins, Harlan T. Pierpont and Maurice F. Reidy, all of Worcester, as trustees. As of Nov. 1, the company had current assets of $1,578,879, and current liabilities of $261,506.

**Savage Arms Corporation.**—The directors on Jan. 27 declared a dividend of 1 per cent on the common stock, par $100, payable March 1. This is the first distribution since Sept. 15, 1920, when a dividend of 1½ per cent was paid.

**Sherwin-Williams Company** declared an extra dividend of 25 cents in addition to the regular quarterly dividend of 50 cents on the common stock, payable Feb. 15; also the regular quarterly dividend of 1¾ per cent on the preferred, payable March 1 to stock of record Feb. 15.

**Standard Oil Company of Indiana** has adopted a plan under which employees will be permitted to subscribe to the capital stock of the company. The plan will become effective April 1, 1926, and operate for three years. Under it, not exceeding 10 per cent of the employees' annual wage will be deducted and placed with trustees to the credit of the employee. The company will contribute an amount equal to 50 per cent of the employees' deposit. Funds so deposited will be used to acquire the company's stock, which will be held by the trustees until fully paid for and then turned over to the employees.

**Standard Oil Company of New Jersey.**—The company has obtained a concession to half the central part of the Buchivacoa properties in Venezuela of the British Controlled Oil Fields, Ltd., on the basis of 12½ per cent royalty on oil produced. The Standard Oil of New Jersey agrees to drill two wells near El Mene 2000 feet deep, and will obtain the right to purchase a maximum of 30,000 barrels of oil daily at market price.

**Standard Sanitary Manufacturing Company** declared a quarterly dividend of $2 a share on the common stock, an increase of 75 cents a share over the previous quarterly payment. The regular quarterly dividend of 1¾ per cent was declared on the preferred stock, both payable Feb. 20.

**Stein-Bloch Company,** manufacturers of men's clothing, have sold an issue of $1,000,000 7 per cent cumulative first preferred stock.

**Stewart-Warner Speedometer Corporation.**—The directors on Jan. 20 declared a quarterly dividend of $1.50 per share on the common stock, no par value, payable Feb. 15. During 1925, the company paid four quarterly dividends of $1.25 per share, and, in addition, an extra dividend of $1 per share, a total of $6 for the year.

**Swift and Company** has acquired the packing plant of Boyd, Lunham and Company at the Union Stockyards, Chicago.

**Trumbull Steel Company** reports operating profit for 1925 of $3,405,962 and net profit of $1,575,570 after all deductions for depreciation, interest and other accounts.

**United Engineering and Foundry Company** declared an extra dividend of $2 a share on the common stock, in addition to the regular quarterly dividends of $2 a share on the common and 1¾ per cent on the preferred, all payable Feb. 6.

**United States Cast Iron Pipe & Foundry Company.**—The directors on Jan. 21 declared four quarterly dividends of 2½ per cent on the outstanding $12,000,000 common stock, par $100, and four quarterly dividends of 1¾ per cent on the outstanding $12,000,000 7 per cent non-cumulative preferred stock, par $100, payable March 15, June 15, Sept. 15 and Dec. 15, respectively. The only other dividends ever paid on the common stock are: 1 per cent in 1905; 4 per cent in 1906 and 4 per cent in 1907; none since.

| *Earnings—Calendar Years* | 1925 | 1924 | 1923 | 1922 |
|---|---|---|---|---|
| Net profit, after taxes & charges | $5,501,265 | $6,020,926 | $3,471,268 | $1,022,243 |

**Ward Baking Corporation** reports earnings, including those from subsidiaries, as follows:

| *Calendar Years* | 1925 | 1924 |
|---|---|---|
| Net earnings | $6,225,582 | $6,417,740 |
| Other income | 613,730 | 331,255 |
| Total income | $6,839,312 | $6,748,995 |
| Interest | 329,926 | 327,395 |
| Depreciation | 1,700,152 | 1,546,658 |
| Federal taxes | 606,090 | 505,203 |
| Ward Baking Co., dividends | 31,069 | |
| Ward Baking Corp. Preferred dividends | 2,201,488 | 2,203,694 |
| Surplus | $1,970,587 | $2,166,045 |

# Quill Pen Methods Were Abandoned Long Ago

NO management would voluntarily go back to the quill pen and its contemporary office appliance. Modern office methods and equipment are so overwhelmingly superior that it is a real cause for wonder that business could struggle along in the old days at all.

Yet, occasionally, we will encounter plant managers using "quill pen" methods in controlling temperatures and pressures. They have yet to learn that man is fallible and hand regulation uncertain.

With Tycos Automatic Controls you can bring your heat processes within the bounds of absolute certainty. They eliminate the human element—the quill pen methods—and give you instead absolute uniformity of product, lesser process time, increased production and no rejections due to over or under heating.

There is a Tycos Catalog for your industry. Send for it today—and tell us your heat process problem. We'll be glad to help you solve it.

*Tycos*

## Automatic Temperature Controls

1. *Tycos* Electric Contact Control
2. *Tycos* Thermo-Tyme Control
3. *Tycos* Dubl-Duty Temperature Regulator
4. *Tycos* Self-Acting Temperature Regulator

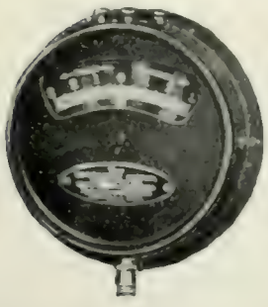
*Taylor Instrument Companies*

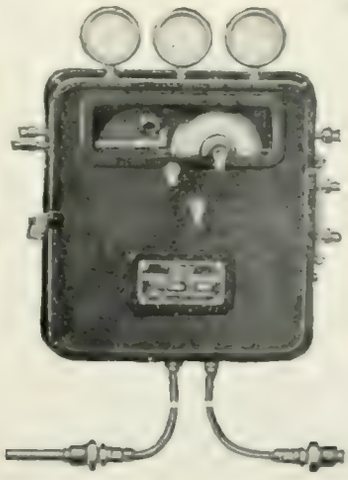
ROCHESTER, N. Y., U. S. A.

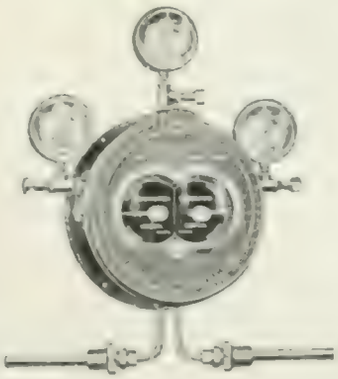
CANADIAN PLANT TYCOS BUILDING, TORONTO

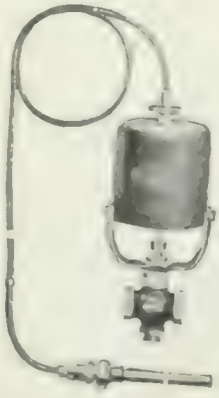
*Manufacturing Distributors in Great Britain*

SHORT & MASON, Ltd., London









# Tycos Temperature Instruments

INDICATING · RECORDING · CONTROLLING

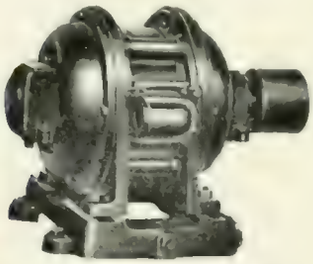
# Wherever power G-E Motors

GENERAL

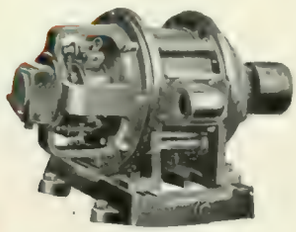
GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

# lines are run----

**Four improved motors for general industrial uses.**

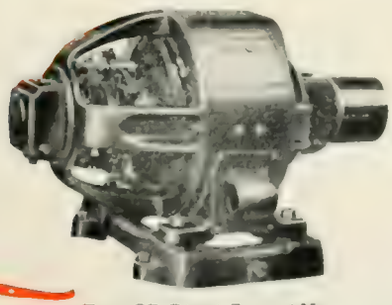


*Type KT Polyphase Motor (900 Series)—Sizes ½ to 15 h.p. inclusive.*



*Type SCR Single Phase Motor—Sizes ¼ to 10 h.p. inclusive.*

*Type BD Direct Current Motor—Sizes ¼ to 3 h.p. inclusive.*



*Type CD Direct Current Motor—Sizes 3 to 200 h.p. inclusive.*

Industries' demands for motorized power exceed 30,000,000 horsepower from electric energy.

General Electric has built more than 20,000,000 horsepower in electric motors—with a range of from 1/200 h.p. to 22,000 h.p., and in thousands of types, sizes, and speeds.

This is your assurance that there is a G-E motor fit for your every need.

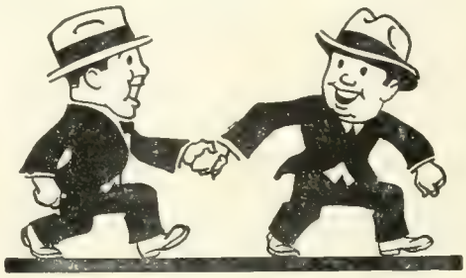
Improvement is the keynote in the design, manufacture, application, and servicing of G-E Motors—improvement in mechanical strength, simplicity, and interchangeability—improvement in workmanship, material, and test—improvement in appearance and finish—improvement in stock, warehousing, repair, and service facilities.

This is your guarantee of full value from an investment in G-E Motors.

**Complete information on G-E General Purpose Small Motors is available at your nearest G-E Office—or G-E Motor Dealer.**

# ELECTRIC

SALES OFFICES IN ALL PRINCIPAL CITIES



# Hand in Hand advertising and lower sales cost

It is to the buyer's interest to know that goods are *sold economically* for he pays the cost of selling just as he pays for the cost of manufacturing.

That's why more and more buyers are scrutinizing sales methods of manufacturers, for they know that excessive sales costs mean either higher prices or shrinking quality.

The seller who clings to antiquated, expensive methods of selling is no more entitled to patronage than one who runs an out-of-date factory.

Machinery has cut costs and standardized products in manufacturing and the *machinery of advertising* is accomplishing similar benefits in selling, for advertising in publications such as this one, is not an added expense, but an improved means of communication that takes the place of slower and more costly methods.

These are demonstrated facts and thinking buyers are recognizing the advantage to them of encouraging progressive, economical sales methods, such as have been adopted by the companies represented in the advertising pages of this journal.

The advertising these companies are doing not only cuts the cost of selling, but it increases production volume, standardizes quality, and is a guarantee of good faith.

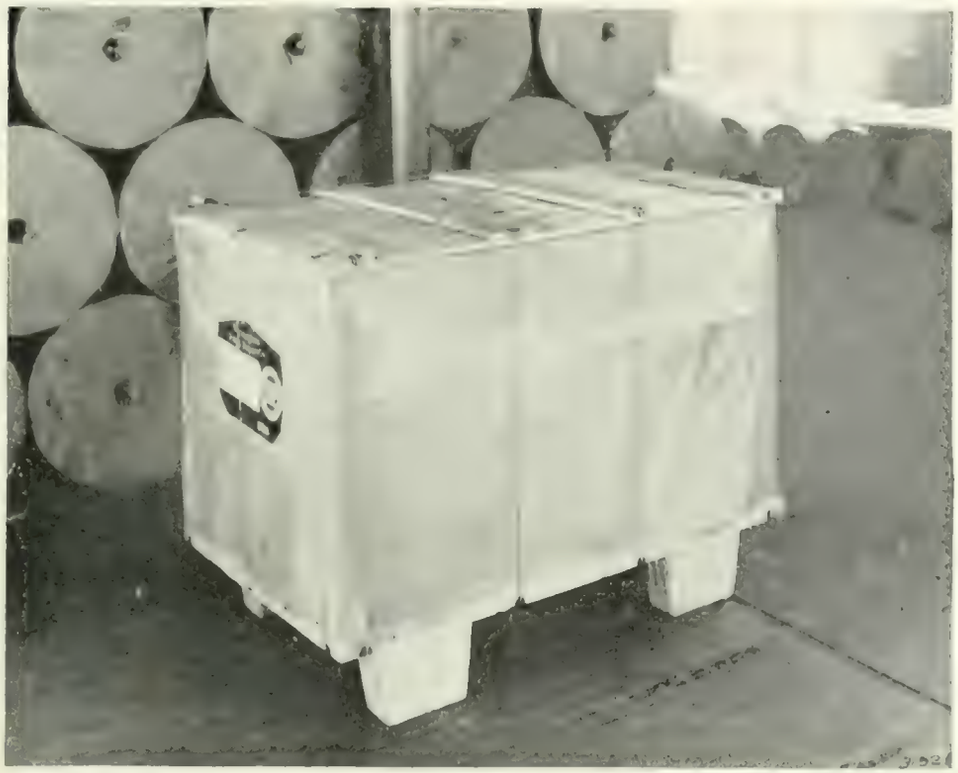
Write us about anything you desire to know about business papers or the fields they cover.

*The*
ASSOCIATED BUSINESS PAPERS, INC.
Headquarters, 220 West 42nd Street, New York City
*Over 120 Publications Reaching 54 Different Fields of Trade and Industry*

A.B.P.

*"Member of The Associated Business Papers, Inc." means proven circulations PLUS the highest standards in all other departments.*

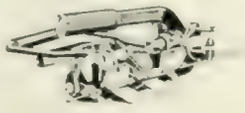
***This publication is a member of the A. B. P.***



GERRARD
The Tie That Binds

*GERRARD UNI-LASTIC STOWAGE*

*The greatest development in carloading in the last century. Ask us how to apply it to your carload shipments at a lower cost than you now must pay and practically eliminate all damage to your shipment.*



*One of the Gerrard group of Wire Tying Machines—the Model "G" Little Giant for heavy packaging and Uni-Lastic Stowage. Ask us how to solve your packaging and shipping problems by this method.*

# Packing Cost Reduced 75%

The skid illustrated above contains **two tons** of paper tied by the Gerrard Method ready for shipment.

In this instance the Gerrard Method saved more than $15.00 in packing cost alone.

This paper was formerly shipped in lots about 500 pounds in heavy cases costing ***$2.50*** each, or a cost of ***$10.00*** per ***ton*** of ***paper.***

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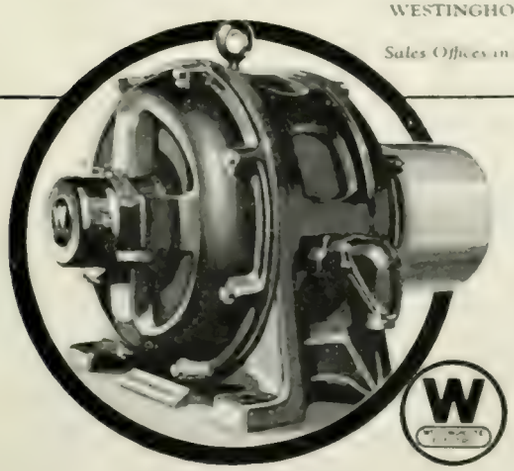


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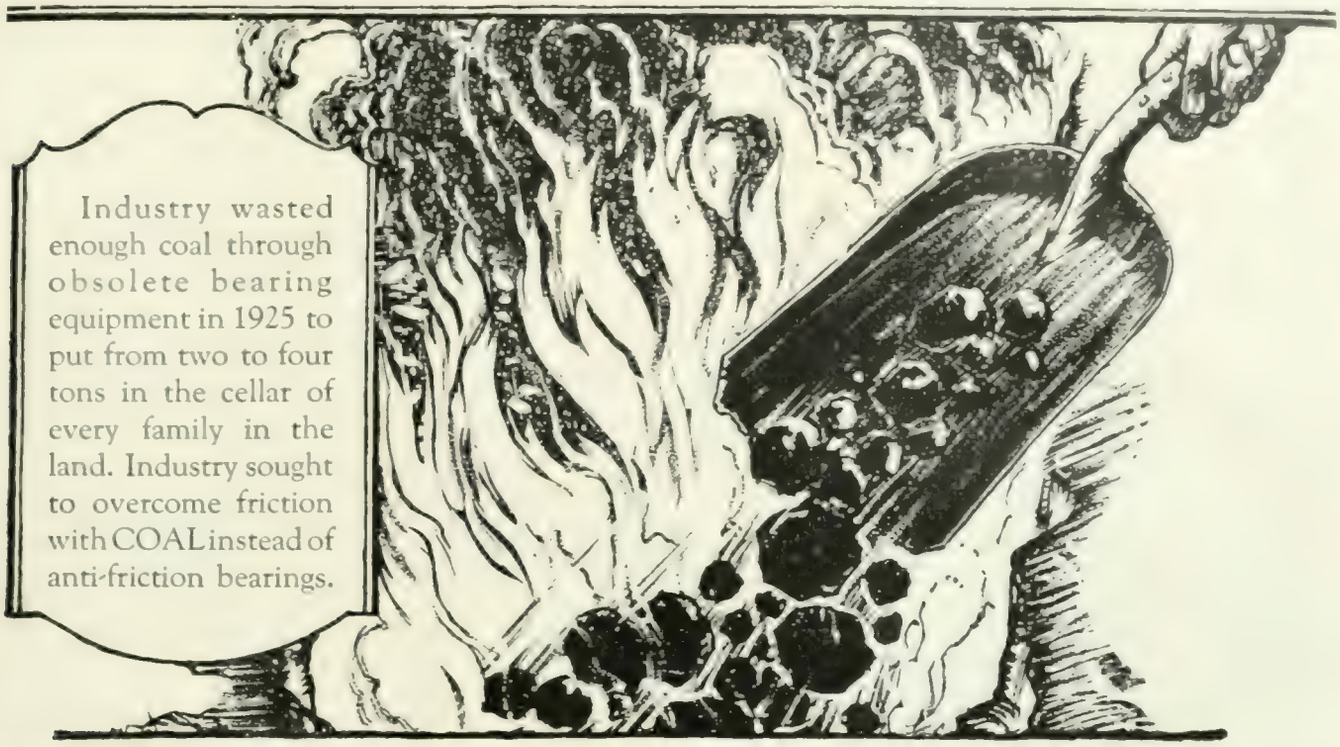
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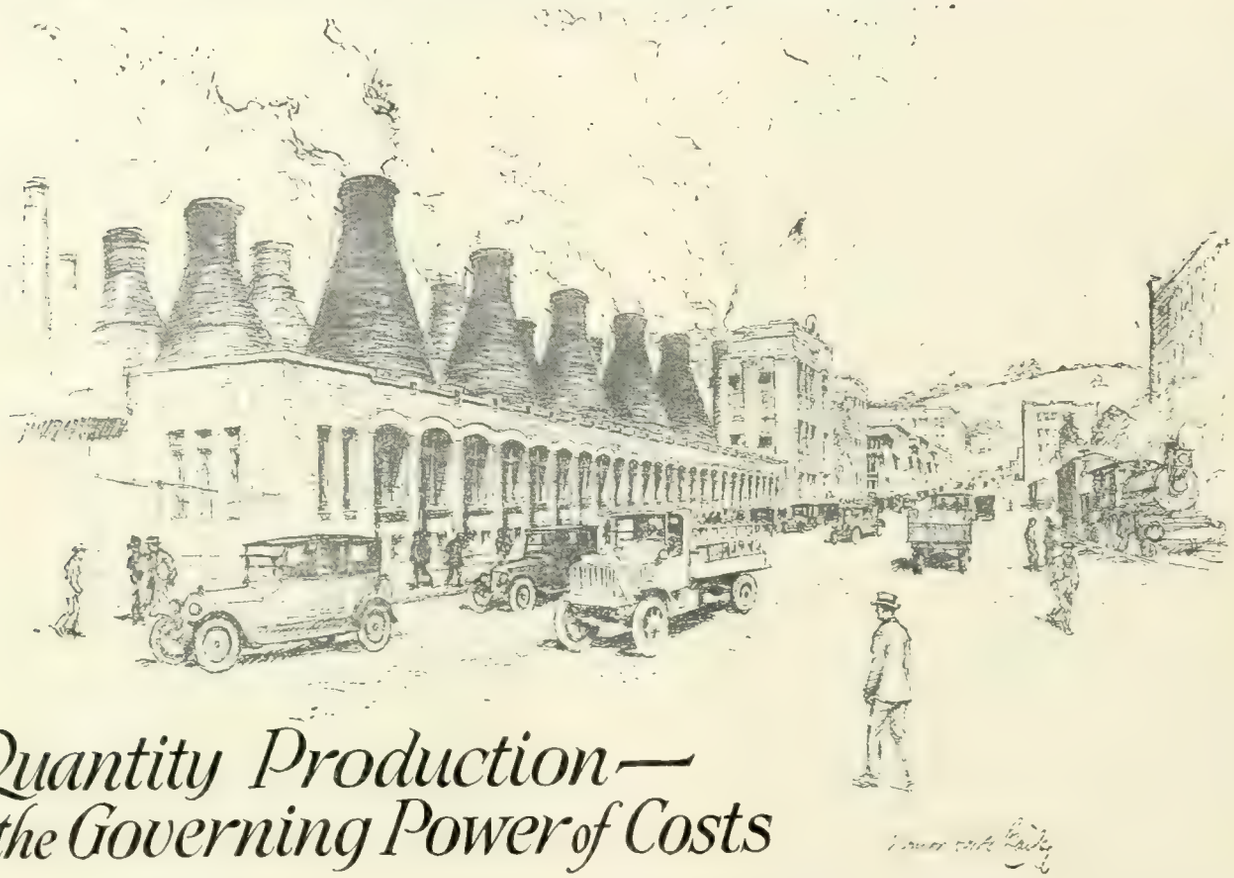

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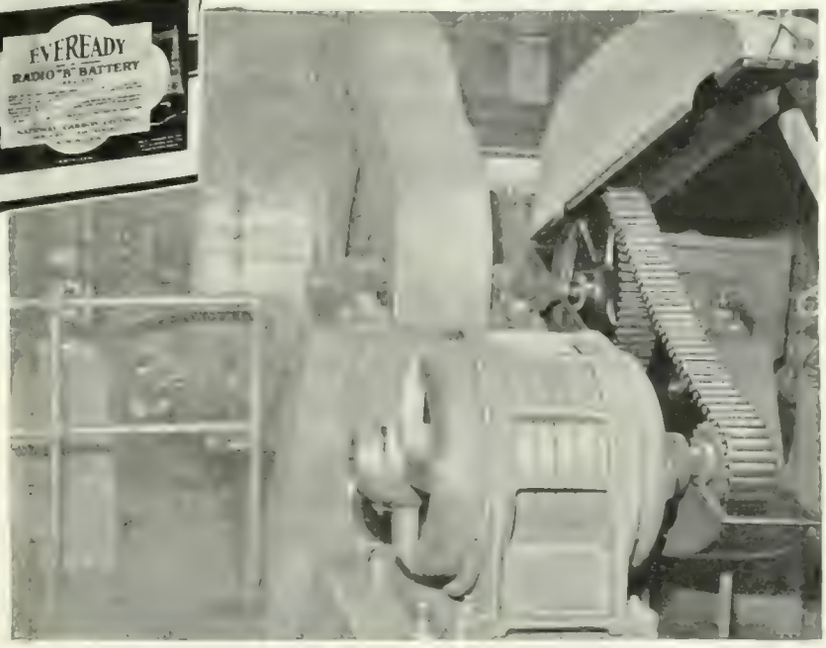

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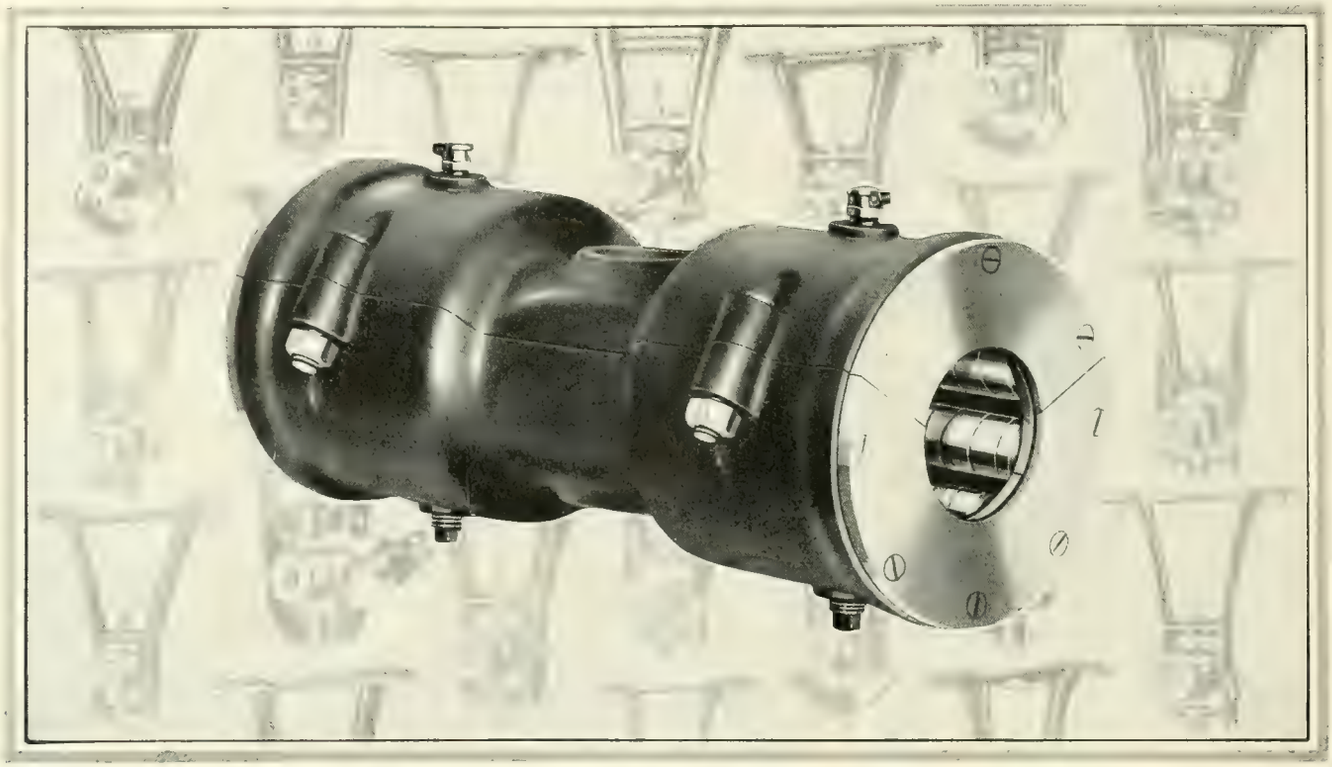

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# MANUFACTURING INDUSTRIES

L. P. Alford, *Editor* — George E. Hagemann, *Associate Editor*

Vol. XI — CONTENTS FOR APRIL, 1926 — No. 4


What Determines Wages in Industry? . . . . . Jacob D. Cox, Jr 245
*President, Cleveland Twist Drill Company*

A 90% Increase in Labor Efficiency . . . . . L. A. Sylvester 249
*Industrial Engineer, The Atlantic Refining Company*

Indicating the Volume of Coming Orders . . . . . Joseph H. Barber 253
*Assistant to President, Walworth Company*

The First Step in Manufacturing . . . . . 256

Successful Budgetary Control in Fine-Paper Mills . . . . . H. M. Grasselt 257
*Formerly Superintendent, American Writing Paper Company*

Modern Design Features New Planer Plant . . . . . Forrest E. Cardullo 261
*Chief Engineer, G. A. Gray Company*

Getting the Right Slant from Charts . . . . . J. B. Conway 266
*The Fulton Company*

Pricing for Profit vs. Pricing for Volume . . . . . W. L. Churchill 267
*Consulting Engineer*

Maintaining Hourly Control of Production . . . . . George G. Brooke 271
*Planning and Production Department, Edward G. Budd Manufacturing Company*

Reorganizing a Run-Down Manufacturing Plant . . . . . E. H. Fish 275
*Mechanical Engineer*

Judging Operating Results . . . . . Arthur Andersen 277
*A[illegible]*

Reducing Costs 22% by Motion Study . . . . . Jos. A. Piacitelli 281
*Engineer, Barber Asphalt Company*

A Double-Purpose Platform for Material Handling . . . . . [illegible] 286

Solving Difficult Handling Problems . . . . . James B. Travers 287
*Assistant Superintendent, Driver-H[illegible]*

The Break-Even-Point Chart—A Management Tool . . . . . F. J. Reuter 290
*Industrial Engineer*

General Motors Purchasing Power Index . . . . . H. G. Weaver 291
*Assistant to Director, Sales Section, [illegible]*

Guide to Latest Information . . . . . 293

News of Manufacturing Industries . . . . . 298


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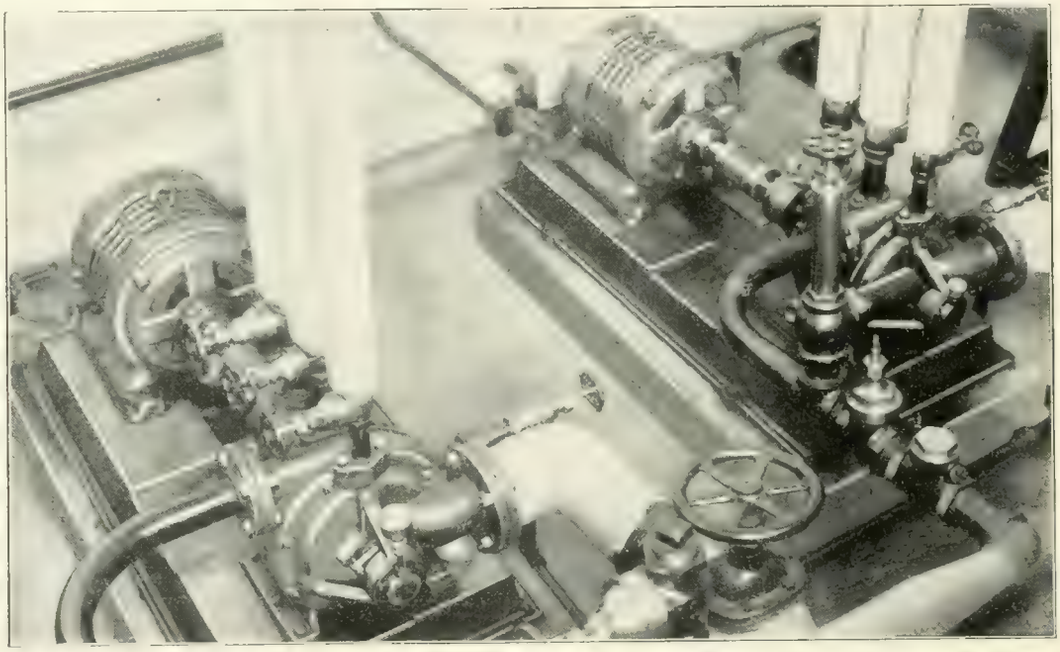

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VOLUME XI APRIL, 1926 NUMBER 4

# What Determines Wages in Industry

By JACOB D. COX, JR.

*President, Cleveland Twist Drill Company*

IN taking up a study of the factors which actually determine money wages the subject seems to divide under three heads controlled by three different sets of economic considerations. The first question to which we must find an answer is, Why do some people and some classes of workers receive higher wages or salaries than others? The second is, Why is the general wage level consistently higher in some countries than in others? And the third is, Why is the general wage level higher in some years than it is in others? We will discuss these in order.[1]

### 1. Relative Wages

The first economic law which influences wages is the law of supply and demand. This is the fundamental cause of wage variations. We find that in every country in the world skilled labor receives a higher wage than unskilled, while the men of the educated professions generally receive higher wages than skilled workers, and again, business executives receive higher wages still. This seems to be due to the fact that there is a shortage or scarcity of the kind of human material which is capable of doing the work of the higher paid occupations. Almost any able-bodied man can do the work of an unskilled laborer, but it takes men of at least average mental capacity and considerable training to acquire the skill which is necessary to admit a man to the ranks of the skilled workers. It takes time and training, and a considerable degree of mental ability to become a good carpenter, or a competent engineer for the handling of a locomotive or a stationary power plant.

It takes a still greater degree of native talent, education, and training to qualify for one of the learned professions. While a business executive must not only have great mental ability, frequently the training of a skilled worker as well as that of a trained professional man, but also the still rarer qualities of leadership—self-reliance, courage, vision, and the ability to secure the loyalty and co-operation of the men under him. The handling and leadership of men is an even more rare gift than the handling of the mental problems of the skilled professions. There are many other occupations, such as that of the actor, writer, artist, minister, teacher and professor, which find their own level somewhere in the scale of salaries paid. A common fundamental is at once suggested.

The law which seems to govern all these various relationships is simply the *law of supply and demand*. If there are many men capable of doing a given class of work, and not much demand for their services, then wages or salaries for that work will be comparatively

[1] From the author's forthcoming book "The Laws of Wages."

low. But if there are very few men who can perform the work competently, and a great deal depends on its being well done, then the salaries paid will be proportionately high.

In a free country like the United States this is practically the only consideration influencing relative wages (that is, the wages or salary of one individual in relation to that of others). In the older countries of Europe and Asia, there are frequently caste and class distinctions which make it practically impossible for a man to rise far above the position in which he was born. But in the United States we may all be thankful that this sort of limitation on ability has been largely eliminated. Here the very best of education is open to any man who is willing to work for it, and a great proportion of our highest paid executives have worked their way up by their own efforts from the most humble beginnings. We in the United States are committed to the belief, which is fundamental to all our institutions, that there is no way so fair and just of determining the reward to be paid each individual as our method of equality of opportunity and free competition. It is our American belief that such conditions offer the greatest probability that the best men will come to the front, and the men receiving the highest personal rewards will be those who have earned them by rendering superior services.

### IMPORTANCE OF MANAGEMENT

In the large industrial units of today a single error of judgment or a single brilliant perception on the part of the manager may be worth more to the company in loss or profit than the entire payroll of the establishment for months. Where so much depends on management of the highest order, and where so few men can be found with the requisite ability, it is not surprising that the salaries paid are very large.

To sum up, then, relative wages depend on the scarcity of men of the required sort of ability, and on the demand that there is for them.

## 2. PROBLEM OF THE GENERAL LEVEL OF WAGES

The second topic is the discussion of the causes of variation in wage levels from one country to another. We find that in every country there is about the same relative proportion between the wages of the skilled and unskilled workers, betwen skilled workers and men of the learned professions, and between men of learning and men of executive ability. But there is a wide variation in the general levels of wages prevailing in the different countries. The wage level of the United States is the highest of any country in the world. England probably comes next at about half the wage scales of this country. France and Belgium are at a level about two-thirds that of England, and Japan and Italy about two-thirds that of France. Germany before the war was practically on a level with England, but is now much lower, while Asiatic and Oriental countries are lower still. Probably the lowest wage levels of the world are to be found in the far east, in India and China. These relations are clearly seen in Fig. 1, taken from The Cleveland Trust Company's business bulletin.

For many years these general relations have remained fairly constant, and it must be clear that there is some fundamental cause at work maintaining these constant differences in levels. This cause undoubtedly must be sought in the conditions of international trade. Very many of the commodities most largely produced and most necessary to human life have an international market. The price of wheat, for instance,

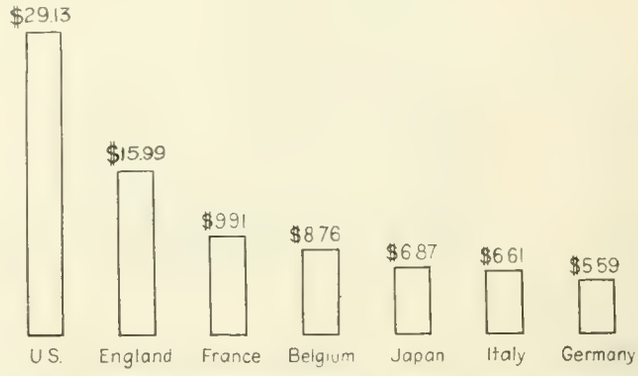



FIG. 1 AVERAGE WEEKLY WAGES OF MEN IN TEN INDUSTRIES IN EACH OF SEVEN COUNTRIES IN 1920

is fixed by world wide harvest conditions, including crop conditions not alone in the United States but in South America, India, Russia and Europe. Wheat raisers of all countries send their crops to the same markets, and a bushel of wheat delivered at Liverpool sells for the price prevailing there, according to its kind and quality, regardless of what part of the world it was raised in, whether in Canada, United States, Australia, Argentina, India, or Russia. Its value in the market is the same, no matter how widely varying may be the conditions of its production. Wages of the harvest hands in Canada or northwestern United States may be six dollars a day, while in the wheat fields of Russia or India the workers may be paid only a few cents a day. Yet a bushel of wheat raised in any of these fields would bring the same price delivered on the wharves of Liverpool, quality being equal.

It is clear that the Canadian farmer paying $5 or $6 a day could not exist in competition with the great land owners of India unless the production of Canadian workers was correspondingly larger than that of the workers of India, or else other costs must be less. If wages in Canada were so high that wheat raising was unprofitable, then wheat farms would be abandoned and the harvest hands would be without employment, while if wheat raising in India or Russia were particularly profitable on account of the low scale of wages, then these lands would be worked to the highest degree, and would become extremely valuable.

Wheat is only one example of the products which enter into international trade. With many other products a similar condition exists. Cotton raised in

the southern states must compete with cotton from India and Egypt. Coal mined in Pennsylvania must compete with coal mined in Wales and Yorkshire. Steel produced in Pittsburgh competes with steel from Sheffield, Belgium, France and Germany.

Wage levels are responsive to the fundamental law of supply and demand. When there is a greater demand for wage earners than can be supplied, wages will rise, as they did in the United States during the war, and when there is a greater supply of wage workers than the industries can use, wages will fall, as they did during the great depression of 1921. As the wage level rises or falls production costs will rise or fall correspondingly. In a country where wages are disproportionately high and unemployment exists, any lowering of wages with its corresponding reduction of costs, will open up possibilities of a wider market. Some established industries will be placed in a better position to meet foreign competition and will secure a much larger volume of orders, while other industries which are not now successfully established will begin to take root and grow and will soon become prosperous. In both types of industry there is created a larger demand for labor, and so after a certain time the surplus labor is absorbed and wage levels cease to fall.

Likewise, in a country where wage levels are disproportionately low, industries will expand and capture the foreign trade of the world, and a strong demand for labor will be established which will presently cause wages and costs to rise until such industries no longer have an advantage in cost of production over those of other countries. Through the higher prices they will thus be obliged to ask, their market outlets will be gradually narrowed until the demand for labor no longer exceeds the supply and then wage levels also will become stabilized.

### WAGE LEVELS DEPEND ON PRODUCTIVE EFFICIENCY

Now the points at which the wage levels of the various countries will stabilize will be roughly proportional to the average productivity of labor in the respective countries. For the wage levels of the respective countries will adjust themselves to such points as approximately equalize the production costs of such goods as are chiefly exported. With production costs of the different countries approximately equal, but with different wage levels, the difference in wages must be due to a difference in the productivity of labor and management in industry.

Of course, it will not necessarily be true of any particular product that the production costs in the different countries will be exactly equal, but there will be a broad general equalizing action between the various countries in the costs of those goods which make up the bulk of international trade, bringing about more or less stable conditions under which the producers of each country are able to secure their fair share of the world's trade and keep their populations normally employed.

Neither does it follow that differences in the average productivity of the labor in different countries are due to labor alone. On the contrary, they are affected by many external conditions such as the efficiency of management, use of machinery, wealth of natural resources, fertility of the soil, density of population, cost of transportation, state of national finances, burden of taxation, intelligence and stability of the government, and many other factors.

If we here in the United States have a high wage level it is because our average *per capita* production is very high and we consequently are able to pay these high wages and still sell our products in competition with the products from other countries. If the wage level in China or India is extremely low it is because the average *per capita* production of their peoples is so low that their products could not be sold in the competitive markets of the world except for the corresponding cheapness of their labor. In any particular country like the United States, we will develop all of those industries which can pay our wage scale and still compete with other countries. Industries which cannot do it will not exist here. Industries which can do it will expand and grow and employ increasing numbers just in proportion as they are able to win their way in the markets of the world.

### LAW OF GENERAL WAGE LEVEL

To sum up, the law of the general wage level is, *the normal wage level of each country depends on and corresponds to that country's general average productivity of labor.* If the wage level be artificially raised and maintained above the natural level, the inevitable effect must be to cause unemployment which will be serious and widespread just in the degree that wage levels are artificially inflated. If high wages are sought as a good and an end in themselves the only way safely to secure them is first to raise the average productivity of labor, through better cooperation between workers and employers, and through better industrial organization, and then allow the higher wages to come of themselves. To attempt the contrary method of raising wages by force, which at the same time creates antagonism between employers and employees and lowers production, is to attempt the impossible and to invite disaster. There is nothing to be gained by such a course but unpleasant experience for all concerned.

## 3. PROBLEM OF PRICE AND WAGE CYCLES

It has been the experience of all industrial countries that prices and wages rise and fall at recurrent intervals, and in recent years students of business affairs have recognized that these rising and falling movements occur in more or less regular cycles.

It seems to be a fact that such recurrent business cycles are largely confined to industrial countries, and in industrial countries their effect seems to be most severe in those industries which are directly concerned with the production of new industrial equipment.

Agricultural countries and agricultural industries as a rule are not so seriously affected, nor are public utilities and industries directly engaged in supplying the necessities of the consumer. Those industries which supply materials or equipment for new construction seem to suffer the most severe fluctuations in demand. The demands of the ultimate consumer for goods for immediate consumption fluctuate comparatively little, but the business of the equipment manufacturer in a rapidly growing country like the United States is always a feast or a famine. He either has more business than he can take care of or practically none at all.

The explanation of this may be easier if we think for a moment how our thrifty mothers bought our clothes in the days when we ourselves were growing children. When it was seen that the old suit would no longer do, mother bought us a new one, not to fit our present dimensions, but one several sizes too big for us so that it would not immediately be outgrown. The United States periodically goes through a somewhat similar experience.

A time of prosperity being with us, we discover that in every direction our equipment is inadequate. Industries in all directions begin to grow and expand. New buildings, new machinery, new equipment of every kind, is needed and needed at once. Practically all industries are running overtime and managers can see no end to the business in sight if they only had the facilities to handle it. Being only human, managers are inclined to become over-enthusiastic and plan for huge expansions. Then presently, often very suddenly, business dies away and it is discovered that like the thrifty mother, business men have provided the country with a new suit of industrial equipment which is several sizes too big for it. Some years of quiet and slow growth will then be necessary before business can fully occupy the new equipment provided. That point having been reached, orders for new equipment presently precipitate a new boom period and so the cycle proceeds, the business peaks being accompanied by periods of inflated prices and wages, and the depressions by corresponding periods of deflation.

The ordinary length of the cycles in this country has apparently been about three and a third years, but not all have been of equal severity. The worst depressions occurred in 1837, 1857, 1873, 1893, 1907, 1914 and 1921.

### Speculative Buying

The possibility of good business seems to depend very largely on the ability, willingness, or we might say eagerness, of people to spend money. Such spenders may be divided into two classes: (1) the consumers who buy goods for their own use, and (2) the investors who are putting money into new construction in order to get a return or profit. The motives which affect the actions of the two classes are somewhat different.

The consumers desire to get as much for their money as possible, but in the immediate future. They buy goods for present or immediate use. Consequently they buy most freely when goods are cheap or when they believe prices are going to rise. Likewise they buy when money is coming the easiest, when business is booming, wages are high and employment plentiful. They decline to buy when they think prices are too high or about to fall, or when times are hard.

The investors on the other hand are looking further ahead and planning for a long-time profit. Like the consumers they endeavor to buy when goods are cheapest, but when prices and wages rise they cease buying and wait for them to fall again. It is well understood among investors that the best time to make long-term investments is following a panic or during a depression when goods and labor are cheap and money becoming plentiful.

The consumer is largely forced to buy, but buying with the investor is optional; he can just as well leave his money in the bank. Thus investors and consumers are sometimes pulling together and sometimes working in opposite directions. On the whole, the investors probably exercise a more powerful influence on business cycles than do the consumers, for the consumers cannot generally afford to wait and so cannot vary their demands to the same extent as do the investors, while the investors have not only current funds to invest, but also the possibility of borrowing against previous investments or against permanent improvements.

### A Conclusion

A conclusion that we cannot avoid is, *when the consuming and investing public have ceased to buy it is hopeless to attempt artificially to sustain prices and wages.* They must be allowed to take their natural course, for only when the decline has reached its natural end will the public again become buyers. Struggling to retard or prevent this natural movement will only result in prolonging the inevitable depression and delaying the return to good times; it means increased suffering from unemployment and prolonged hardships for the wage earners. It would be far better to expedite the process of deflation in a reasonable and fair way and secure a return to good times as soon as possible, especially because all production costs decline as the wage level declines and the standard of living of the workers is in no way permanently impaired.

### The Best Wage Level

One hundred percent operation of industry and full employment, with a job for every man who wants one, is the most desirable condition for all parties in industry. The best wage level is the level which will tend most surely and most promptly to bring about such a condition, regardless of whether it seems high or low when expressed in dollars. This, of course, is the natural wage level, the one which results from the free and unhampered working of economic law.

# A 90% Increase in Labor Efficiency

## What a Group Bonus Accomplished in Work of a Wharf Gang Handling Barrels, Drums and Kegs

By L. A. SYLVESTER

*Industrial Engineer, The Atlantic Refining Company*

THE development of the group bonus in recent years has been slow but steady. Its advent was little heralded and yet it is perhaps one of the most important and interesting subjects in management. The idea of gang piece rates is old, but the treating of an entire working unit as a group, the inclusion of foremen and non-productive labor in the incentive plan is a new thought that has made rather

FIG. 1 RECEIVING AND STORING BARRELS ON WHARF

rapid strides. Is this form of incentive to be universally adopted and to supplant entirely the individual piece rate? Or has it a limited field in which it possesses particular merit and leaves another field to the individual rate?

It would be perhaps premature to offer answers to these questions. However, experiments with the group incentives are being made and an account of actual experiences should tend to shed light on the subject as a whole. A good comparative study has been made of a labor gang as it passed through successive stages of day rate, piece rate and finally group incentive.

Conditions were particularly favorable in this case for a comparison of the effectiveness of the incentives because over a two-year period there was a surprisingly low labor turnover, in fact the original gang is still practically intact from the foreman down. The nature of the business has not undergone any important change. The equipment used has been unaltered except for changes during the period in which the standardization of the work was perfected prior to the creation of the piece rates. Of course it would not be possible to draw sweeping conclusions from the results in one case. However, an analysis of a comparative nature should help to bring to light the nature and fundamental strength or weakness of the group incentive.

In passing, it might be well to note that there is a certain reluctance in the minds of many, particularly those of us who have been laboring to develop exact methods for the measurement of work, in regard to the group incentive. With it has been connected the idea that it can be very rapidly installed, and that careful and painstaking time and motion study is not needed. However, quite the contrary is true if the best results are to be obtained. Any incentive is merely a device for securing co-operation and perpetuating a given set of working conditions. It is perfectly possible to install group incentives as well as any other incentive upon the basis of existing working conditions. However, the greatest return is received if the work is measured by time and motion study, for then the method will be more perfect and the consequent revenue greater.

### THE GANG AND ITS WORK

About the beginning of 1924 we undertook the study of the work of one of the gangs handling filled oil barrels, storing them upon a wharf, and loading them upon lighters. See Figs. 1, 2 and 3. The stowing of barrels upon lighters is similar to stevedoring and the other work would be classed as heavy common labor. The membership of the gang was chiefly negro, somewhat above the general average in intelligence and understanding of the work for that class of labor. For several years the foreman had held the same gang together and had instilled a good spirit of harmony and helpfulness among themselves. He experienced no difficulty in securing sudden bursts of work to rush out special shipments.

From the standpoint of incentives the work of the gang presented a complex problem because of the variable conditions to be dealt with. The product

handled varied from regular 50-gallon wood barrels, up to 110-gallon drums at one extreme, and down to small kegs at the other. The bulk of the work was the regular wood or steel barrel or drum. At times, when shipments were delayed by the tardy arrival of vessels, the space upon the wharf would become congested, and it would be necessary to store the barrels two or three tiers high. Extra labor was required in both putting up and tearing down the extra tiers. The barrels were received at the wharf by railroad car and naturally the cars could not always be spotted directly at the point in the wharf where the packages were to be stored. Consequently, the barrels would have to be moved, either at the time they were received or at the time of shipment. Some of this shifting of cars or barrels could be avoided by tiering.

However, neither the shifting or tiering of barrels were productive operations and the setting of prices on them opened the way for the doing of unnecessary work during dull times, and yet it was difficult to say that it was entirely unnecessary. As in all shipping departments, the bane of existence was the changing, cancelling and delaying of shipping instructions. The weather and particularly a seven-foot rise and fall of tide changed working conditions and varied the number of men required to do the task. While there was usually ample time to do the actual loading between the arrival of lighters and their scheduled departure, nevertheless it was necessary occasionally to increase the size of the gang to load the cargo in the minimum elapsed time. Despite all these variables, a rigid inspection and careful coopering had to be maintained at all times to safeguard quality.

### Evolution of the Gang

The history of the gang during a two-year period is vividly told in Fig. 4. It will be noted that four distinct stages are marked off on the curve. The first was the existing one found when investigation of the department was started. The work was all paid at day and hourly rates. Then followed the period of observation, experimentation and installation of piece and premium rates. The third stage was the piece work and finally came the group incentive period.

### The Day Work Period

The existing condition, at the commencement of the industrial engineering investigation, was carefully studied. The costs were high and the general appearance of the wharf was not satisfactory. The foreman had succeeded in building up a good gang spirit, but it was evident that one explanation for this might have been the low efficiency shown on the chart. It is not always true that little work will make a cheerful gang, however the absence of driving and an easy going pace of work does not place any strain on the relationship between men and foreman. Emphasis had been laid upon the importance of making shipments on time and little stress was laid upon cost. At any rate, the cost factor was something which had only to be reckoned with occasionally, when the quarterly figures were made up, and that always seemed remote. If a shipment was an hour late the foreman heard about it immediately and in no uncertain terms.

### The Installation Period

The reason the chart shows a gradual tendency for the efficiency to rise almost from the first day of the installation work, is because a production report was immediately installed and real sales effort put back of it. Not only the foreman and his assistant but the clerk and the laborers themselves were interested in barrels per man hour. Some half dozen different methods of loading a lighter were tried and the criticisms of the men listened to. The importance of these experiments was not so much that they developed anything new, but they did create interest in the speed

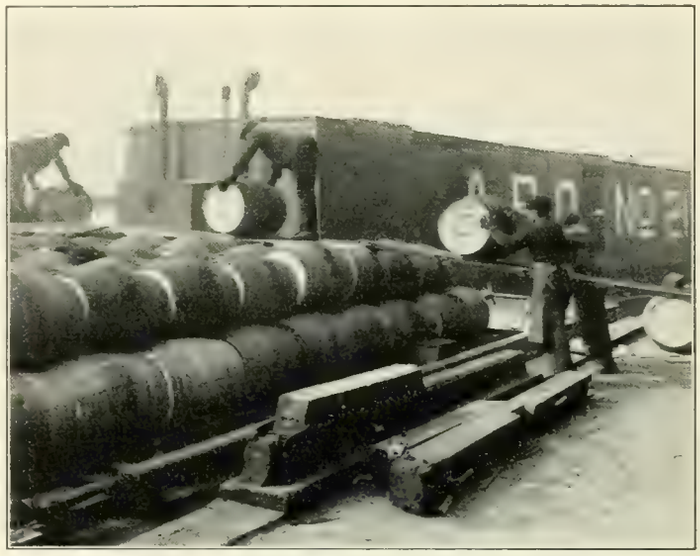


Fig. 2 Loading Open Lighter at High Tide

Fig. 3 Loading House Lighter at Half Tide

of work. Some actual improvements were made; by shaking faith in the perfection of the existing methods the way was opened for some betterments later effected by the gang itself. As the efficiency of the gang increased there was some weeding out of the less valuable members, which again reacted in a tendency to a rising efficiency. Along with this cost and delivery speed were linked together. It was frequently pointed out that just as great certainty in meeting scheduled shipping time could be procured with lower costs.

One by one the various jobs and classes of work

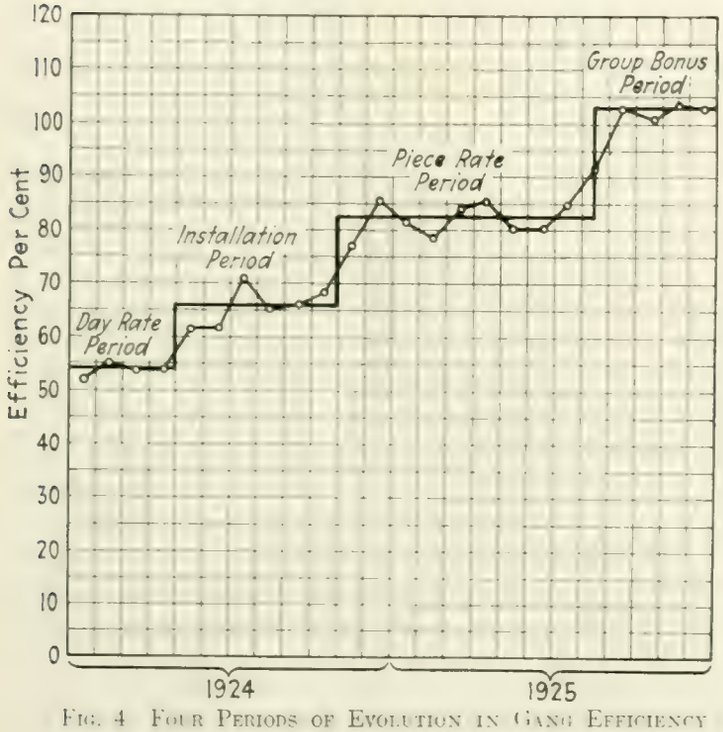



FIG. 4 FOUR PERIODS OF EVOLUTION IN GANG EFFICIENCY

were covered by standards, and rates were established. Those operations on which the conditions were fairly standard straight piece rates with day rate guarantees were used. Where the work was subject to severe condition variables, a premium rate with a gradual increase as the production rose above a given minimum was used.

### THE PIECE WORK PERIOD

After the establishment of the piece rate the general aspect of the wharf was similar to any typical piece work department. The gang was, if anything, more wide awake than before and when there was a reasonable volume of work it was done quickly and at high efficiency. The question will naturally rise in anyone's mind as to why the gang did not reach 100 per cent efficiency during this period. First of all, in any strictly piece work department when the efficiency is figured for a monthly period, it will always be found that enough delays, interruptions of work and other variables have occurred to pull the average efficiency down, even where the rates are perfectly accurate and the operators are 100 per cent in skill and efficiency. In addition to this fact, there was in this particular case a variation in the volume of work going through the wharf daily and it required very careful changing of the number of men put to work in order to be able to reach the 100 per cent mark daily. There was still a good bit of anxiety in the foreman's mind about meeting his schedule delivery times and he naturally had a tendency to play safe. This margin of safety is really the chief reason why the efficiency never reached higher levels. Then, too, there were the really slack days upon which no extra earnings were made and the entire gang fell back upon the guaranteed day rate. It is needless to add that on such days the cost was high and the general average efficiency for the month was thereby lowered.

### THE GROUP INCENTIVE PERIOD

Having successfully experimented with the group bonus idea in other departments it was decided to install a group bonus plan for the wharf gang and see its general effect. It was felt that the wharf at that time was in a satisfactory condition and there were grave doubts whether the change would effect any benefit. The group bonus plan which was tried contained essentially the following features:

1. The bonus was computed from precisely the same standard rates of production as the piece and premium rates had been figured.
2. The bonus was paid as a flat percent of each man's hourly or daily rate both for direct and indirect labor. The highest paid man, the foreman, therefore received the largest actual bonus but the same percent as the rest of his gang.
3. The bonus was computed upon a two week period.
4. Standard amounts of indirect labor (foreman, clerk, janitor service, coopering and inspecting) were allowed and the savings effect in this direction were the justification of the bonus payment to the indirect workers.

The entire plan was carefully prepared and carefully presented to the men. It required only a day or two to develop the fact that the plan was extremely unpopular with them. Every effort was made to find out the reasons for this unfavorable reaction. During the time that the matter was under consideration the gang worked in excellent style. For the first two weeks, the men were frankly outspoken in their criticisms of the plan, but nevertheless raised the efficiency score to the highest yet recorded. Analysis of all the criticisms of the plan resolved themselves into a few objections.

1. The thought that the bonus to be paid to the foreman and the indirect workers must be coming out of the direct labor's pay.
2. After a hard day's work the men wanted to be able to know how much they had earned. They felt that the bonus being averaged over a two week period, there was always a good chance of losing some of the bonus they had earned through bad breaks in the latter part of the period.

The first objection was explained away after considerable effort but the second one was not so easily handled. The objection seemed a fair one even though

it was not strictly true as a matter of mathematics, yet it was so essentially human that the plan was modified to permit the direct labor to be paid on a daily basis and the indirect retained on the two-week basis. The reason for computing on a two-week basis was not so much the fact that it facilitated the clerical and payroll work as that the nature of the work was

TABLE 1. GROUP BONUS TABLE GIVING THE BONUS PAID AT VARIOUS EFFICIENCIES

| Efficiency | Bonus Per Cent | Efficiency | Bonus Per Cent |
|---|---|---|---|
| 66 | .6 | 96 | 16.1 |
| 67 | .9 | 97 | 17. |
| 68 | 1.1 | 98 | 18 |
| 69 | 1.2 | 99 | 19 |
| 70 | 1.2 | 100 | 20. |
| 71 | 1.2 | 101 | 21. |
| 72 | 1.3 | 102 | 22. |
| 73 | 1.3 | 103 | 23. |
| 74 | 1.4 | 104 | 24. |
| 75 | 1.6 | 105 | 25. |
| 76 | 1.8 | 106 | 26. |
| 77 | 2.1 | 107 | 27. |
| 78 | 2.4 | 108 | 28. |
| 79 | 2.8 | 109 | 29. |
| 80 | 3.3 | 110 | 30. |
| 81 | 3.8 | 111 | 31. |
| 82 | 4.4 | 112 | 32. |
| 83 | 5.0 | 113 | 33. |
| 84 | 5.7 | 114 | 34. |
| 85 | 6.4 | 115 | 35. |
| 86 | 7.2 | 116 | 36. |
| 87 | 8.0 | 117 | 37. |
| 88 | 8.8 | 118 | 38. |
| 89 | 9.7 | 119 | 39. |
| 90 | 10.6 | 120 | 40. |
| 91 | 11.5 | 121 | 41. |
| 92 | 12.4 | 122 | 42. |
| 93 | 13.3 | 123 | 43. |
| 94 | 14.2 | 124 | 44. |
| 95 | 15.2 | 125 | 45. |

For efficiencies over 125 per cent add 1 per cent bonus for each additional per cent of efficiency. Any bonus in excess of 100 per cent shall be paid as 100 per cent bonus.

such, that by saving work from one day to another all of the easy work could be done one day at high bonus and all of the difficult jobs held to another when the bonus would not have been great at any rate. By keeping the foreman and clerk on a two-week basis the temptation to do such juggling was removed.

Naturally this plan appealed strongly to the indirect workers because of the money involved. All of the indirect workers became conscious of the fact that the direct laboring gang had their eyes on them and were anxious to show that they too were helping to earn the bonus. As the plan got under way a fact that appealed strongly to all was that there were no longer any jobs which did not pay bonus. Any bonus earned was earned on the full working day.

The biggest gain under the group plan occurred on the slack days. Under the straight piece work plan a slack day was paid at the guaranteed day rate and costs went skyrocketing. Under the group plan a minimum of labor was brought in on the dull day. Some days the foreman and a checker did the entire work of the department at a low cost and nevertheless a high bonus was earned by them.

Turning now to a few details of the results secured. the average hourly earnings of laborers were:

| | Cents Per Hour |
|---|---|
| Day work | 48 |
| Installation period | 49 |
| Piecework | 53 |
| Group bonus | 58 |

The percentages of bonus earned in these same periods were:

| | Per Cent Bonus Earned |
|---|---|
| Day work | 0 |
| Installation period | 2 |
| Piecework | 10 |
| Group bonus | 21 |

Table 1, the group bonus table, gives the bonus paid at various efficiencies.

There seems to be one fundamental strength to the group incentive. All of us are conscious of being pleased by the thought that others, particularly our comrades and fellow workers, think well of us. So with the group incentive the real driving force within it, is the desire in every worker's mind to satisfy his peers that he did his share. We always have with piece work a certain reluctance on the part of workers to do their real best for fear that the rest of the gang will feel that they are "showing off for the boss," "sucking in," or "killing the job."

No matter how fixed has been the policy regarding rate cutting, public opinion among the workers through kidding and passing remarks at lunch hour, and on the way back and forth from work, acts as a brake upon the effectiveness of the individual incentive of the old style. Public opinion under the group incentive has the opposite effect and actually stimulates to greater effort. A worker feels that he can give his very best and that it is to everyone's benefit.

Down in the bottom of the heart of many a foreman of piece work gangs, is a certain resentment or jealousy at seeing the piece workers earn close to his own rate or perhaps even exceed his earnings. At times, when he could help his men out of a difficulty, he will fail to render aid. However, under a group bonus incentive he has every reason to be of assistance at all times. In the case of the wharf, not only did the foreman and clerk pitch in and work frequently with the gang, but the gang minimized the amount of supervision needed through intelligent interest in the work performed.

Group incentives are still too new and too few data as to experiments with them are now available to draw general conclusions. However, where a homogeneous working group is dealt with, this analysis would seem to indicate that the group incentive has several strong points not found in the individual incentives.

1. The opinion of his fellow workers stimulates each man to do his best.
2. It eliminates all jealousy of the piece workers' earnings from the indirect workers' mind.
3. It is highly stimulating to the most valuable man in the group, the foreman.
4. It eliminates the suspicion of favoritism in giving out the piece work.
5. It taps a great source of efficiency very deeply. It secures wholehearted intelligence, interest and enthusiasm from the entire working force.

# Foreseeing Volume of Coming Orders

## From Changes in Gross Profit Margins

By JOSEPH H. BARBER

*Assistant to President, Walworth Company*

"ALL roads lead to Rome." Those solid old roads, built centuries ago, but that persist in their good service even until today, are counted as one of the wonders of the world. Radiating in all directions from the Eternal City they became throbbing arteries of commerce and predetermined the goals of all conquest.

In our attempted industrial control we quickly learned that the budget could perfect a system of arteries through which would flow the virile policy control to stimulate a complete but compact organization. We found that the budget could determine the goals of industrial conquest. But just as all roads used to lead to Rome, so in budgeting we found all control problems traced back to sales. Back of all problems seemed to be the initial problem, What is the prospective quantity of order demand?

**What the manufacturer most wants to know about is future orders for his product. These are influenced by the buyers' confidence. Prospect of increasing profit margins increases orders; prospect of decreasing profit margins decreases orders. Mr. Barber has constructed a barometer curve from four groups of Federal Reserve statistics that indicate the change in gross profit margins. In this article he shows in full detail how to construct this curve, so any manufacturer can have it currently for his guidance.**

With us this was a real problem. In one of my first discussions[1] I said, "It would be highly desirable to discover some external barometer cycle which would always predict our cycle. We have not been able to find it. Probably such an external cycle for us does not exist. For, it will be recalled, not only 'manufacturers' but also 'orders' are both classed as the very first to reflect cycle changes."

In acknowledging the difficulty of our problem, I had the consolation of a conviction that, by the nature of the case, there should not be any automatic forecaster for our particular business. This seemed obvious to me, because, in a rather extended discussion earlier in my book, I derived the conclusion that any *quantity* record of *orders* should turn up or down earlier than almost any other index.

I have more recently confirmed that earlier conclusion. In the case of every industry with which I have since come in contact I have observed the necessity of talking a common language in terms of quantity of orders received. If we do talk this common language, we find that we all have common experiences, for in nearly every case the timing of changes in all series of orders received will correspond surprisingly closely with, or a month ahead of, the stock market movements. So, it will be admitted, it is a very real problem to attempt to forecast order movements that are dominated by essentially the same speculative sentiment or "confidence" as is reflected in the security markets.

Nevertheless, I could not accept the possibility of a phenomenon without a cause. The only problem, of course, was to isolate and measure the cause or causes. Results of a first attempt toward getting back at causes were given in one of my earlier articles which contains subject matter since incorporated in Chapter 4 of my book.

It is recognized that in the case of such a problem one must needs be more of an economist than a statistician, and more of a business man than an economist. A business man cannot always wait for the development of well formulated economic theories any more than the economist can defer formulating his theories until there are at hand precise statistical data worked with mathematical finesse.

Since my earlier attempts toward a solution of the major problem of forecasting, it became my privilege to sit in more and more with the group of controlling executives, to catch a glimpse of their mental processes, and to identify one by one the facts or impressions that tend materially to affect their executive decisions. As a consequence, I have come to feel that business cycles rest upon very human foundations, and that only as we come to understand human reactions can we come to understand more and more about business cycles.

My attempt in this article is simply to carry forward one step further the analysis of subsidiary cycles. I admit that there are many statistical imperfections due to attempting comparison of series which may not be *precisely* comparable. Although lack of time has limited the extent of the study, I have come to feel from a few rough tests that, if precisely comparable

[1] "Budgeting to the Business Cycle," page 36

series of data could be obtained, the major impressions yielded for guiding the executive in his decisions would not be greatly modified.

What I have to say can be said briefly. What I have come to feel is that all executive decisions trace back to waxing or waning confidence, and that this, in business, means the gradually developing "awareness" of increasing or decreasing profits. Increasing demand volumes certainly wait upon the *evidence* of returning confidence. Granting that, one should next admit that conscious decisions to increase prices should very probably wait upon the evidence of demand in good volumes. Now, confidence will always be returning when prices are relatively low and a wider profit margin is in prospect.

Accordingly, since it is true that fixed overhead charges can always be distributed over the many units

TABLE 1. EXPLANATION OF SOURCES AND METHODS

| Cycle Numbered | |
|---|---|
| 1 | Index of Factory Payrolls in Manufacturing Industries, Federal Reserve Bulletin, February, 1926. No seasonal correction, but shifted by short method to base 1921–1923 monthly average = 100. |
| 2 | Index of Production in Basic Industries, same Federal Reserve Bulletin. Index base not shifted because 1921–1923 base is essentially equivalent to the 1919 base. Seasonally corrected. |
| 4 | Federal Reserve wholesale price index of raw materials, same Federal Reserve Bulletin. No seasonal correction, but shown in per cent of base, shifted by short method to base 1921–1923 monthly average = 100. |
| 6. | Federal Reserve wholesale price index of consumer's goods, same Federal Reserve Bulletin. No seasonal correction, but shown in per cent of base, shifted by short method to base 1921–1923 monthly average = 100. |

The variable costs index, numbered 5, assumes that the factory payrolls index is broadly representative of total United States industrial payroll cycles, and that the basic production index fairly corresponds to the cycles of all industrial production. In fact, the basic production index (upon a base which could be shifted, as was required) checks well against other authoritative indexes claiming to gage the variations of all industrial production. Necessarily, all the indexes utilized were shifted by the short method to a recent base period, but, when thus expressed in common denominator terms, Money Paid was divided by Production Received, month by month, to secure a Labor Cost per Unit index. This resulting index of labor costs was then averaged (two-thirds—one-third weighting, respectively), with the index of raw material prices, thereby deriving the variable costs index shown.

of cost—if only volume can be obtained—this final analysis implies that the problem actually reduces itself to an inquiry relating to *gross profit margins*. When there is a trend toward better selling prices over cost, the widening gross profit margins will always be reflected shortly by forward commitments in increasing quantities. In other words, widening gross profit margins should always predict an oncoming increase in demand and, conversely, narrowing profit margins should predict an oncoming decrease in volume of demand.

Again, to carry the thought just one step further, having in mind the mental reaction of an enterpriser in business, it is the *prospect of increasing* gross profit margins that, at a still earlier date, predicts an increase in the quantity of demand. And, in like manner, it is the *prospect of decreasing* gross profit margins that predicts, timely, a decrease in quantity of demand.

Fig. 1 and Table 1 tell the story in concrete fashion. Probably very little needs to be added, because the sources, methods and formulas utilized are all indicated. Beginning at the top of Fig. 1 we divided *money paid* (factory payrolls) by *production gotten* to derive an index of the *labor cost per unit*. This index of labor cost per unit we then averaged with the index of *raw material prices per unit*. This gave an index of the variable costs per unit. We then divided the index of *selling prices* by the index of variable costs per unit, and thereby derived finally an index

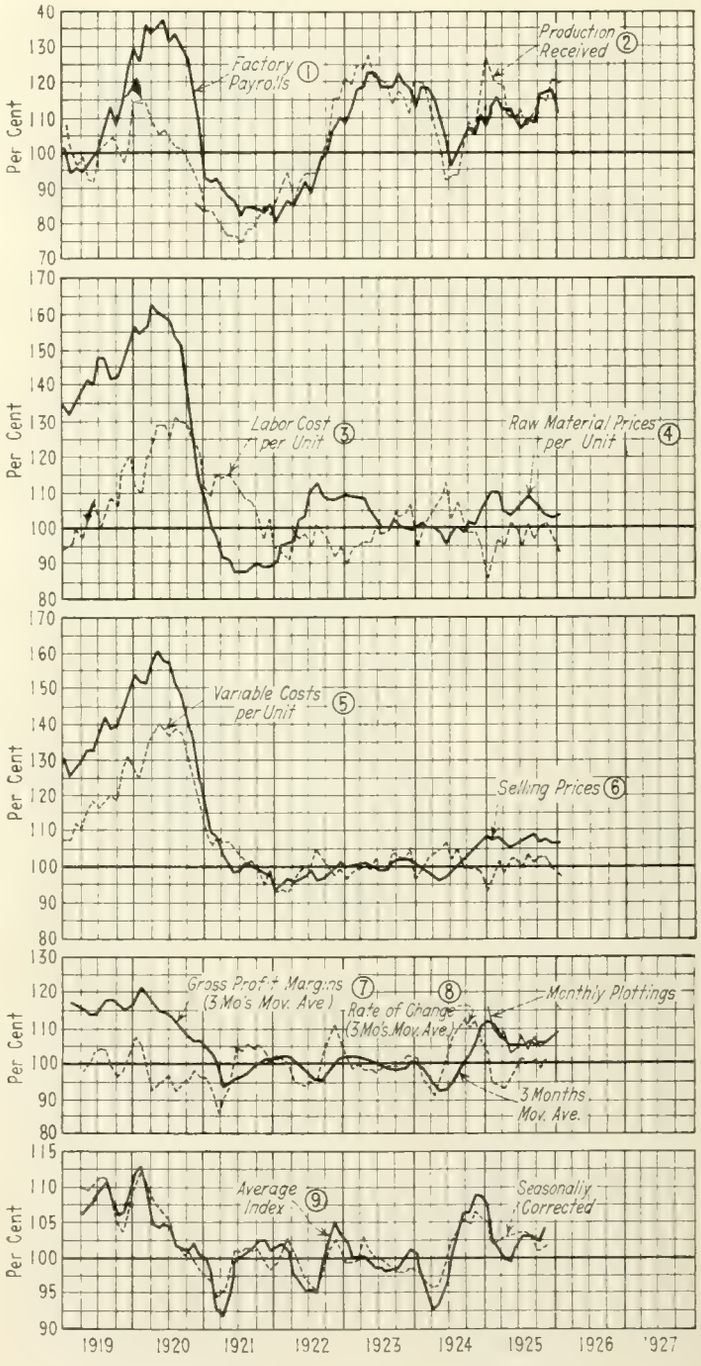
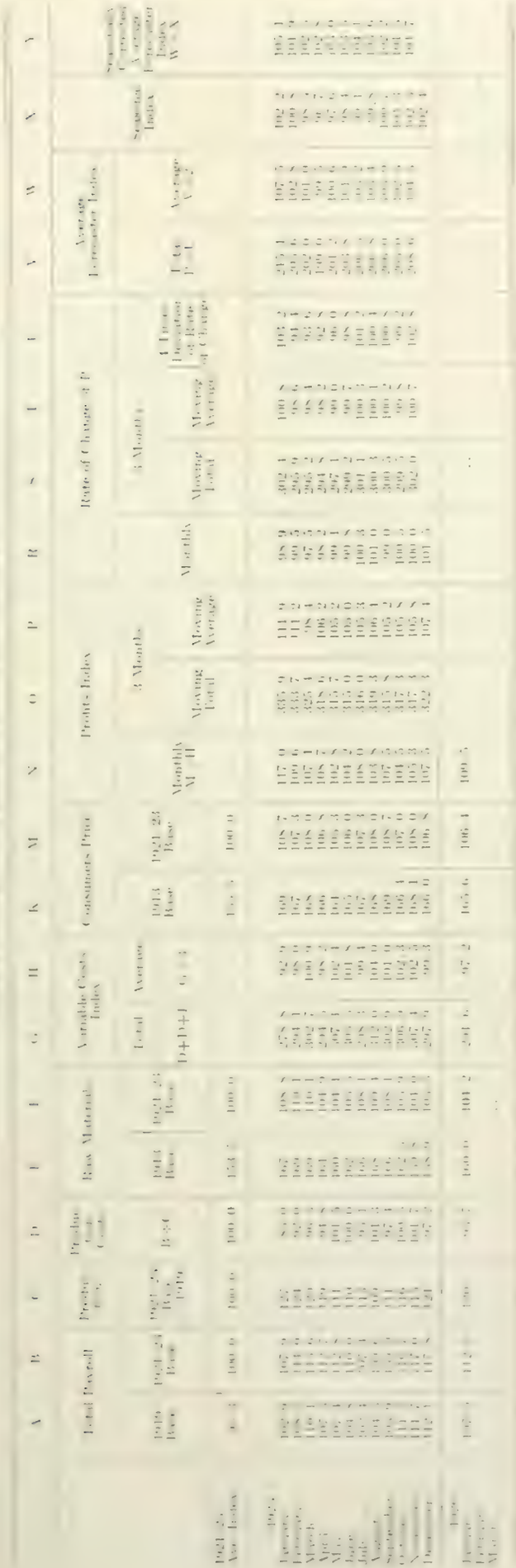



FIG. 1 FORECASTER OF GROSS PROFIT MARGIN

of *gross profit margins* (slightly smoothed by a three-months' moving average). This index line alone tells a fairly definite story. For example it was declining continuously from the early part of 1920.

At this point we must consider the psychology of a decline. Profit margins were just as wide at the middle of 1920 as they were at the middle of 1919. However, quite in contrast with the mid-1919 large quantity of order demand, there was in early 1920 a serious collapse in the quantity of order demand that

TABLE 2. GROSS PROFIT MARGINS INDEX CALCULATION



at that time quite definitely forecasted an immediate decline in the stock market. In other words, it was the consciousness that profit margins were declining, rather than increasing, that gradually tempered all executive decisions and moderated their forward commitments.

In an attempt to take a statistical measure of the mental reaction, I utilized a *rate of change* index

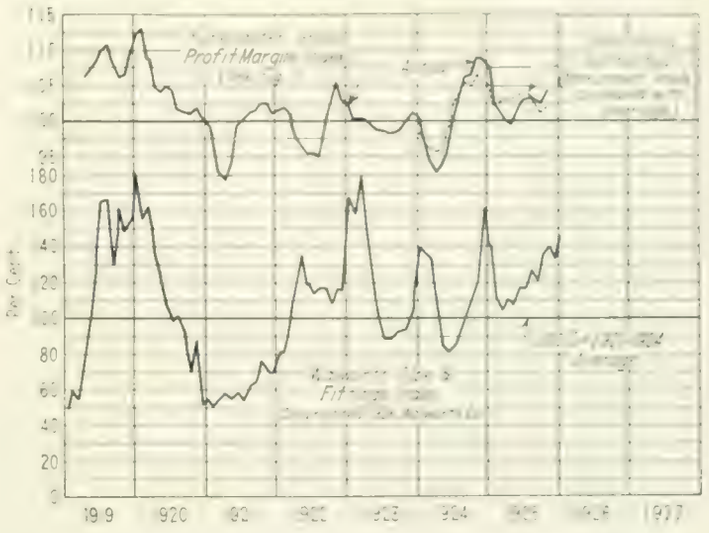



FIG. 2 COMPARISON OF UNITED STATES GROSS PROFIT MARGINS FORECASTER AGAINST WALWORTH PIPE AND FITTINGS INDEX

based upon the gross profit margins index. This device is simple and may be easily understood. The method consists only of calculating the percentage by which, let us say, the February 1920 plotting of the gross profit margins index exceeded the January 1920 plotting of the gross profit margins index. Thus, there was in February 1920 still to be indicated some increase, but it was not so much of an increase as had been registered by the January 1920 index when referred against the December 1919 index. In other words, the prospect for increasing profit margins had lessened and there was the first indication of declining order volumes.

If the ratio representing the rate of change were itself averaged with the calculated index of gross profit margins, this reliable indicator of the mental impressions as to gross profit margins would be outdominated by the index representing the mere width of the gross profit margin. So to give greater influence to the rate of change, when taking a final average, I have multiplied by four its deviations from 100, and then re-figured these exaggerated deviations in terms of the 100 per cent basis. The gross profit margins index and the exaggerated rate of change index are then both in terms for averaging, fifty-fifty, for a final index.

This final index shows as a full line at the bottom of Fig. 1. However, there seems to be a seasonal movement in the line so that, for what it is worth, there is shown also at the bottom of the chart, a dotted line representing the seasonally corrected "average index."

As is plainly observable from the chart, at the present moment, we have long since passed the high peak of stimulation toward large volume ordering rates, due to the prospect of increasing profit margins, and, if we conceive of the seasonally corrected average index as having any value, it is to be noted that that index has been declining sharply during the latest two months for which we can post the smoothed dotted-line curve.

It is always valuable to check up one's theoretical assumptions, and I have done so by comparing this new gross profit margins forecaster, which is representative of general conditions in the United States, against a reliable index of quantity ordering demand, which is also indicative of average U. S. conditions.

The Walworth Company has recently copyrighted an index of quantity ordering demand rates from the actual trade experience reflected upon the pipe and fittings industry throughout the United States. However, since the products of the pipe and fittings industry filter into the nooks and corners of every other industry, we may presume to say that the pipe and fittings index is simply a measure of the quantity ordering rates in the many, many industries that create a consumer demand for pipe and fittings.

Fig. 2 shows the comparison of the United States gross profit margins forecaster against this pipe and fittings index. Even a casual analysis of the forecasting value of the gross profit margins forecaster fairly well substantiates the conclusion that it is the prospect of changing gross profit margins that creates the confidence that leads to an increased quantity of forward contracting or ordering. Forward ordering then stimulates a further confidence that evidences itself, first, in the highly flexible stock market movements; next, in the slightly less flexible commodity price quotations; then, somewhat later, in the rather more sluggishly controlled, and steadier, production rates; and, finally, the confidence is reflected in increasing interest rates as developing over-production forces manufacturers to resort to current financing by the banks through the medium of commercial loans.

For some time I have hesitated to release this gross profit margins forecaster index because I am fully aware of the many criticisms that can be offered by statistical-minded persons. Nevertheless, I am convinced that, to a business man, it tells a vital story that he can get in no other way.

# The First Step in Manufacturing

WHEN Old Man Jones was actively at the head of his business there was peace for everyone in the Jones Mfg. Co. except those who were in his disfavor. His wars were short and always ended in unconditional surrender or "Go." Jones made money and men. None of his men knew how much he paid others but each was satisfied with what he got. If anyone was dissatisfied Jones knew it as soon as he did, and there was a brief battle with its ending.

"Came the time," as they say in the movies, when Mrs. Jones permanently gave up getting six o'clock breakfasts and darning sox. For a year the old man mourned. Then he buried himself in work. Then he went to a convention of his National Association and came back with a new wife who had the ability to spend what Mrs. Jones No. 1 had saved.

Jones listened to the new Mrs. Jones; he had also heard a paper on democracy in industry. The two fitted together. He assembled his staff, told them he had made his pile, was sorry it was so big, and that he wanted them to take hold, run the business and ultimately buy him out with the profits. Everybody was happy. The bookkeeper became Auditor, the foreman was Works Manager, the assistant foreman Superintendent; everyone spelled his position with capital initials. Jobs no longer existed.

Jones took his new wife on the honeymoon he had promised his first one. The first mail that reached him in France had letters from all of his staff but one. Alike, except in wording, they said, "Why don't I get as much as Smith?" Smith was the one who did not write. Jones cabled the treasurer to fix them all up alike. The next day brought a cable from Smith, "Do I have to do all the work and see these men loaf around doing nothing?" Jones cabled each man a proportionate share of proxies on his stock and told them to fight it out.

Fight they did. If the business had been less profitable than a gold mine there would have been nothing left. The president was not the head; he just sat at the end of the table. The treasurer ran his department his way. The production department bought what it pleased and when. The cost department split overhead a new way to show that the best seller was a total loss. The sales department sold what the production department said it could not make and the treasurer said he could not collect for.

There was complete democracy between these five or six men. All drew the same pay, did as they pleased, and mighty little went on the black side of the profit and loss account.

Then Mr. Jones, who did not want to be the "Old Man," came back. He no sooner sat at his desk than the staff appeared, first to welcome him, then to consult him. Each one got a decision, and went away happy, not because the decision pleased him but because he was relieved of the burden of making it. Harmony prevailed.

Jones was non-plussed. "Why can't these boys work without me around. All I do is tell them to do something that they know perfectly well how to do without me? Why did they spend all the time scrapping?"

He never got the answer. But to the outsider the answer is easy. It is the necessity for only one boss.

# Successful Budgetary Control of Production in Fine-Paper Mills

By H. M. GRASSELT

*Formerly Secretary-Treasurer, American Writing Paper Company*

TO the manufacturer of fine-papers, that is, papers with a rag fibre content of up to 100 per cent, the last few months of the year of 1920 marked the advent of decisive changes in the entire processes of manufacturing and distribution. The demand for rag-content papers decreased perceptibly. During the war people had been educated and urged to "use something cheaper." Consequently cheaper sulphite papers, that is, papers made of wood fibres exclusively, gained popularity and took more and more the place of rag fibre papers. Manufacturers of bond papers, ledgers, papeteries and other fine-papers consequently had to adjust themselves to the new order of things. They had the alternative, either to meet current requirements or gradually lose out in the struggle.

**Budgetary control in fine-paper making co-ordinates production and sales, schedules runs, sets up standards, initiates economical purchasing and checks labor and indirect expenses. It is easily installed in mills producing "mill brands." It is more difficult to set up and operate in the manufacture of "private brands." Inasmuch as cost records are indispensable to the effectiveness of the budget, the cost department has become the center of administration, and the cost man investigates and checks up deviations from estimates and standards.**

Such a situation prevailed and still prevails to a certain extent in the fine-paper industry. Obviously, machinery and equipment cannot be changed or replaced at a moment's notice and, therefore, in order to successfully compete and realize at least a small margin of profit on their investments, manufacturers adopted stringent economies in administration and manufacture.

Due to certain peculiarities in the process of paper-making, waste always caused considerable loss. Hence, elimination of waste was the first step to be taken toward readjustment. A detailed study of each department and its practice and a careful research into the entire sequence of operations led to the elimination of wastages or at least reduced them to a minimum.

Elmination of waste brought about standardization of grades, sizes and colors. Countless grades of fine-papers had caused rather confusion among consumers. Grades were reduced to definite numbers; manufacturers began to make the right paper for the right purpose.

Standardization of products naturally led to the introduction of standard formulas for the individual grades. Thus a decided simplification of purchasing methods took place. Yearly requirements could be predetermined more accurately and shaped into a functioning purchasing budget. Materials could be bought more economical than before, guesswork became eliminated and prompt deliveries insured uninterrupted operations. No hurried, unexpected purchases had to be made, which would have meant higher prices and additional express charges or other extra transportation costs, and thus higher material costs.

Budgetary control of administrative and manufacturing activities became now well established in fine-paper mills.

Production and sale of the respective commodities constitute in every manufacturing establishment the principal source of income and profit. The Production or Manufacturing Budget, therefore, in fine-paper mills receives the closest attention of executives; it guides them in their decisions and controls the activities of manufacturing processes.

In establishing the Production Budget, the production manager of the manufacturing department in cooperation with the sales department determines the total quantity of each grade of paper to be produced and sold during the budget period. These predetermined standards are based upon actual figures from previous records over a certain period and, intelligent interpretation and forecast of conditions.

Having a dependable guide for its activities, the sales department is now enabled to concentrate its efforts in the right direction at a minimum of cost. The sales quota for each grade has to be filled and the salesman on the road knows exactly how much there is required to attain the figure set forth in the budget. The manufacturing department or the production manager uses the budget as a means for intelligent planning and control of operations. The production is scheduled so that deliveries can be made according to specifications and promises made to customers. Economical runs can be planned ahead and costly, frequent changes in the manufacture of the individual grades avoided.

Budgetary control of production is comparatively easy in mills that carry standard lines of "mills brands" which are manufactured into stock and delivered from stock. Here, however, an effective control of "stock

on hand" must be exercised to supplement the budget.

Mills that make many "private brands," manufactured to order, are put before a more difficult task. Here the operation of the budget depends largely on conditions and the influx of such customer's orders. In this case, production cannot be budgeted in detail, because of the impossibility of predetermining orders accurately.

Predetermined quanities and qualities and the logical introduction of standard formulas simplified the work in the plant. Standardized processes mean higher efficiency in every department. In the rag room only definite grades of rags are used and thus, standard sorting rates can be established and piece work introduced.

It is obvious, that cost records are indispensable to the effectiveness of the production budget. Hence, in fine-paper mills, the cost department has become the center of control of operations and activities. Its daily reports reflect the efficiency of each department, and it is the duty of the cost man to report immediately or investigate any deviations from standards established by the budget.

Table 1 represents a form of a production budget as used in fine-paper mills. The estimated normal production is listed according to the total predetermined production per grade, per pounds, and per hour as well, to the total number of hours required to produce the budget quota of the respective grade of paper.

In the fine-paper industry approximately 85 per cent of the total time, or 500 productive hours in a month, is generally considered "normal." Daily comparison of reported results to established standards is, therefore, absolutely necessary to attain results through the budget.

Operatives, such as machine tenders, are required to state in their daily reports the cause of any delay that will cause a deviation from the standards. If, for instance, a new felt or new machine wire has to be put on the paper machine, the unproductive hours thus caused must be stated in the daily cost reports. However, in many instances, the cause of delays other than those stated, the length of time needed to resume operations, etc., are carefully analysed and efforts made to reduce such shutdowns to a minimum.

Table 2 illustrates a monthly "Production and Manufacturing Expense Budget." This is, in reality, a sub-budget to the production budget. It can be easily seen, that the estimated monthly production has been derived from the general production budget.

This form renders efficacious service in comparison of the various estimate expense items to actual results. Labor expenses should be stable under normal conditions. An analysis of operations and conditions enables the management to determine the exact number of employees that are required to operate a department successfully and efficiently under normal conditions. A well-devised payroll analysis supplies at the end of a cost period the actual labor expenditures in the individual departments. To render possible proper distribution of labor charges, the plant has been departmentalized and the respective departments or processes have received a symbol number. The payroll department compiles the daily labor distribution sheets according to these symbols and exhibits the results in the periodical payroll anlysis.

Each department foreman has been supplied with a list of the standard number of employees required to run his respective department efficiently.

Supplies expenses are predetermined from actual records. Record of felts and wires establish average

TABLE 1. PRODUCTION BUDGET

| Machine | Grades | Estimated Normal | | | Actual | | | Per Cent Normal | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | Production | Pounds per Hour | Total Hours | Production | Pounds per Hour | Total Hours | | |
| #1 | No. 1 Bond | | | | | | | | |
| | No. 2 Bond | | | | | | | | |
| | No. 3 Bond | | | | | | | | |
| | No. 4 Bond | | | | | | | | |
| | Special Bond | | | | | | | | |
| | Special W. M. | | | | | | | | |
| #2 | No. 1 Ledger | | | | | | | | |
| | No. 2 Ledger | | | | | | | | |
| | No. 3 Ledger | | | | | | | | |
| | No. 4 Ledger | | | | | | | | |
| | Special Ledger | | | | | | | | |
| | No. 1 Papeteries | | | | | | | | |
| | No. 2 Papeteries | | | | | | | | |

TABLE 2. PRODUCTION AND MANUFACTURING EXPENSE BUDGET FOR MONTH OF.....1926

| Department and Items | Production | | Per Cent Over or Under | Expenses | | Per Cent Over or Under | Oper. Total E. H. or M. H. | Per Cent of Normal Operation | Actual Expense to Date | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | Estimated Normal Capacity | Actual True Quantity | | Estimated | Actual | | | | | |
| Rag Room | | | | | | | | | | |
| Labor | | | | | | | | | | |
| Supplies | | | | | | | | | | |
| Fixed Charges | 000 | 000 | 00 | | | | | | | |
| Indirect Charges (Power, heat, etc.) | | | | | | | | | | |
| Totals | | | | | | | | | | |
| Bleach | | | | | | | | | | |
| Items as above | 000 | 000 | 00 | | | | | | | |
| Washers | | | | | | | | | | |
| Items as above | 0000 | 000 | 00 | | | | | | | |
| Beaters | | | | | | | | | | |
| Items as above (Here the total must be divided by the number of paper machines and the results distributed to them) | 000 | 000 | 00 | | | | | | | |
| Paper Mach. #1 | | | | | | | | | | |
| Labor | | | | | | | | | | |
| Supplies | | | | | | | | | | |
| Fixed Charges | | | | | | | | | | |
| Indirect Charges | | | | | | | | | | |
| Beater Department | | | | | | | | | | |

lengths of service and, thus, operating factors.

Fixed charges applicable to operating departments are made up of: (1) Taxes, personal property; (2), depreciation and maintenance of equipment; (3), insurance of equipment. The expenses of running the beaters and other equipment auxiliary to them (Jordans, etc.) have been distributed to the general paper machines on a percentage based on the width of the deckel. The auxiliary charges are: (1) Steam; (2), power; (3), building expenses; (4), millwright; (5), general plant expenses.

TABLE 3. MANUFACTURING COST AND OPERATING CONTROL EXHIBIT FOR OPERATING DEPARTMENTS FOR THE MONTH OF.....1926

| | | Wet- | Beat- | Ma- | | Loft | Cal- | Sort- | ming | General Fin- ishing | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Supplies... | | | | | | | | | | | |
| Fixed Charges. | | | | | | | | | | | |
| Total..... | | | | | | | | | | | |
| Sub-Total.. | | | | | | | | | | | |
| Beaters..... | | | | | | | | | | | |
| Per Cent Normal ..... | | | | | | | | | | | |
| Actual Operation.... | | | | | | | | | | | |
| Per Cent Normal | | | | | | | | | | | |
| Normal | | | | | | | | | | | |

Table 3, "Manufacturing Cost and Operating Control Exhibit" illustrates a monthly summary of monthly normal operating costs and actual operating expenses. An analysis of this statement discloses to the executive the efficiency of the individual departments. It shows, whether the plant has run normally and whether the results achieved conform to the predetermined standards. If there are glaring discrepancies, the respective cases are thoroughly investigated and corrective measure adopted.

The advantages of budgetary control of production in fine-paper making may be summed up as follows:

1. Co-ordination of production and sales. The sales department knows the yearly production capacity in regard to various grades and regulates its policies and advertising campaigns accordingly.
2. The production manager is enabled to schedule economical runs; he knows exactly what he is required to do in order to satisfy the sales department. The adoption of standard rates, standard hourly production rates and standards for raw materials render possible an accurate control over operations and expenses.
3. The purchasing department is in a position to schedule buying according to the production budget and thus initiate economical purchasing policies. Knowing the approximate requirements as to quantities and quality of raw materials that are needed to manufacture to meet the predetermined production budget figures, the purchasing department can plan its buying ahead and insure prompt deliveries. The purchasing agent is in a position to find the best sources of raw materials and knowing the quantities he needs annually, he can obtain more favorable terms than the buyer who buys according to his immediate requirements.
4. The production budget controls the actual production and its cost; it controls the labor expense and keeps it down at a normal basis.

Of course, the budget does not directly increase production and decrease costs, but it checks up on operations and expenses and properly founded and utilized, will eliminate many deficient features and detriments and show a way to increase profits.

A monthly analysis of departmental activities and comparison of actual performances and results with budget estimates distinctly disclosed the various benefits realizable from the operation of a production and manufacturing budget. A final summary at the end of the first budget year showed, that centralized control over operations and introduction of standard production rates for all producing units or processes, effected increased efficiency throughout the plant. The average production gradually rose from 5 per cent below to 7 per cent over the estimated standard rates. The actual net production at the close of the budget year was 4 per cent higher than the budget estimate and the forecast in sales of the individual grades was 96 per cent correct.

Manufacturing expenses were within 5 per cent of the correct ratio to estimated expenses. There was a decided decline in actual labor expenses noticeable. In former years, labor expenses were entirely out of proportion to actual production, whenever there happened to be a dull period and the plant or producing units had to close down. Centralized budgetary control brought about 98 per cent of accuracy in the average, and even in the very short periods of forced

idleness on account of poor industrial conditions during July and August, labor expenses were kept in approximate ratio to actual production results.

Intensive sales activities and advertising campaigns, planned and executed according to the budget, resulted in the attainment of 96 per cent of accuracy in sales estimates, as stated before. Logically, employees had steady work, which increased the efficiency of the force and reduced the cost of labor turn-over to a minimum.

The well-planned routine of operations and production enabled the management to keep its inventories of raw materials at a minimum and thus avoid unnecessary tying up of funds.

Budgetary control, furthermore, improved co-operation among department heads. The complete control exercised over the respective phases of production in the various units and departments, together with the increasing efficiency of the operatives rendered possible a better linking-up of processes and operations. The flow of materials from process to process or from department to department became regulated and functioned far better than before the adoption of centralized budgetary control. Production was conform to schedule in the paper machines and the paper in turn, delivered to schedule to the subsequent finishing processes. Thus a good of friction among department foremen was removed effectively and for good.

The first year of budgetary production control meant a decided success. All components were analysed and a revision took place, whenever the operation of the budget and results obtained made such a procedure necessary. The results attained during the first two months of the second budget year, indicate, that final figures at the end of the second year will excel those of the first budget period. The "Monthly Production and Manufacturing Expense Budget" shows, that production and expenses are accurately controlled.

# Industrial and Public Utility Profits in 1925

ANNUAL earnings statements now available for 294 industrial, mercantile, and public utility corporations indicate that net profits of such concerns in 1925 were about 30 per cent larger than in 1924, or in 1923. While these statements represent simply a sampling of all concerns, the concerns included are sufficiently representative so that the conclusion may fairly be drawn that the year was one of very large profits. These large profits accompanied unusually high levels of production and trade in 1925, but, with a few exceptions, relatively stable prices of manufactured goods.

Rubber companies reported the largest increase in profits compared with either 1924 or 1923, and the gains for the oil and automobile industries also were unusually large, though automobile production was only slightly larger than in 1923. Profits of tobacco companies, miscellaneous industrials, and stores included in the tabulation have increased steadily during the past three years.

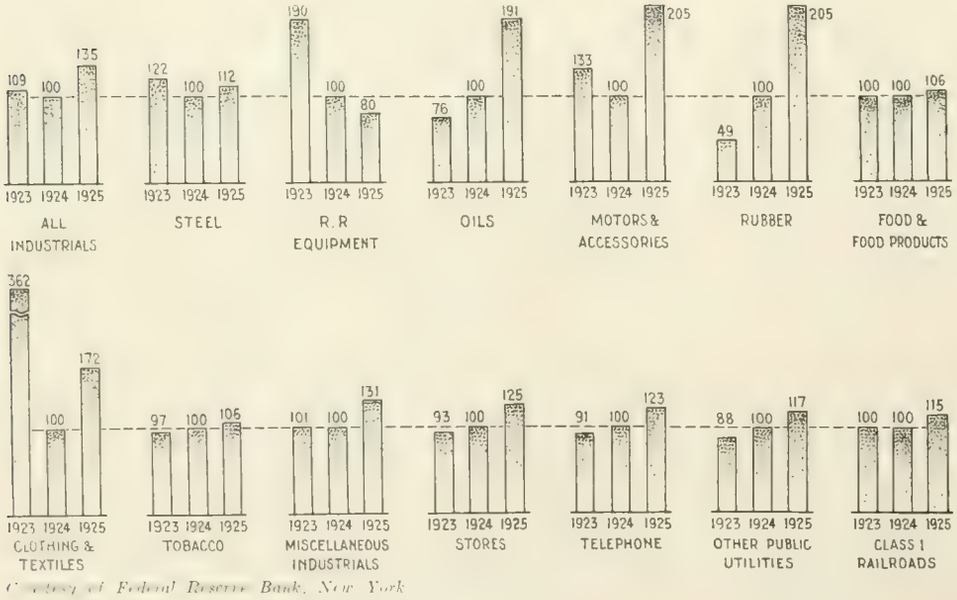
In the clothing and textile group 1925 profits were well above those of 1924 but less than half those of 1923. The railroad equipment industry was the only group to show a decrease compared with 1924.

Telephone companies and other public utilities continued to report steady increases in net earnings. The profits of Class I railroads showed a 15 per cent increase over 1924 and were the largest in recent years. The net profits of 191 railroads (Class I) in 1923 was $983,736, in 1924, $986,718 and in 1926, $1,136,984.

TABLE 1. INDUSTRIAL AND PUBLIC UTILITY PROFITS IN 1923, 1924 AND 1925

| | Number of Corp. | Net profits in thousands of dollars 1923 | 1924 | 1925 |
|---|---|---|---|---|
| Steel Companies | 11 | $142,901 | $116,765 | $130,632 |
| R. R. Equipment | 9 | 23,047 | 12,115 | 9,742 |
| Oils | 14 | 23,721 | 31,366 | 60,005 |
| Motors and Motor Accessories | 16 | 103,946 | 78,424 | 160,882 |
| Rubber | 7 | 11,635 | 23,517 | 48,313 |
| Food and Food Products | 23 | 77,937 | 77,782 | 82,753 |
| Clothing and Textiles | 16 | 25,262 | 6,979 | 11,991 |
| Tobacco | 8 | 38,681 | 39,944 | 42,319 |
| Misc. Industrials | 73 | 161,658 | 160,462 | 209,593 |
| Stores | 13 | 62,599 | 67,203 | 83,908 |
| Total 10 Groups | 190 | $671,387 | $614,557 | $840,138 |
| Telephone | 68 | $136,705 | $150,793 | $185,500 [2] |
| Other Public Utilities | 36 | 111,713 | 127,116 | 149,092 |
| Total Public Utilities | 104 | $248,418 | $277,909 | $334,592 [2] |
| Total 12 Groups | 294 | $919,805 | $892,466 | $1,174,730 |

[1] Exclusive of tires
[2] Partly estimated




Courtesy of Federal Reserve Bank, New York

FIG. 1 ANNUAL (1925) NET PROFITS OF 294 CORPORATIONS IN PERCENTAGES OF 1924

# Modern Design Features New Planer Plant

## G. A. Gray Company Builds World's Largest Factory for This Type of Machine Tool Product

By FORREST E. CARDULLO

*Chief Engineer, G. A. Gray Company*

IN May 1925 ground was broken for the new plant of the G. A. Gray Company, Cincinnati, Ohio, manufacturers of metal planers. Construction work was pushed rapidly and by November the plant was finished and ready for occupancy. It is the largest factory in the world devoted exclusively to the manufacture of planers.

The property at the new site was purchased in 1924 and plans were developed for the building. While the equipment in use at the former location was of the very best, the structures were of an older type and the ground area was insufficient for the facilities which the business required. It was impossible to expand the property at this location, and the company did not wish to build a multi-story shop because the planer parts manufactured were becoming too large and heavy to handle to advantage in that type of building.

Suitable manufacturing sites for the machine tool industry are difficult to obtain in the most favorable parts of the city, but the locality is an important center for the production of equipment for the metal trades, and consequently has an unusually high-class supply of skilled labor. These factors made it very desirable to secure a property within the city limits. Fortunately, a very good site was finally located in a part of the city convenient for the workmen's residence and having exceptional fine shipping facilities.

The plant is of one story construction. It has a main bay 420 ft. long and 60 ft. wide, a side bay 420 by 50 ft., and on the other side a bay 300 ft. long and 100 ft. wide divided into eight sections 20 and 40 ft. wide, running perpendicular to the main plant. In the main bay there is a clear height of 23 ft. 6 in. below the crane hook while in the 50 ft. bay this height is 17 ft. The 40 ft. sections alternately have high and low roofs, the high roofs being of monitor construction and the low roofs flat. In one of these sections is the only two-story portion provided in the shop—a foreman's room built on a mezzanine floor.

A two-story office building extends across the front of the shops. This building is 80 ft. wide and 30 ft. deep. The lower floor is occupied by the general offices and the upper floor by the engineering and drafting departments and production offices.

The plant is built of brick on a steel framework and concrete foundations. Column footings are on 50 ft. reinforced concrete piles. The brickwork in the office portion is ornamental and is composed of Alliance "Autumn Blend" brick with a lamp black mortar joint. The style of architecture adopted was suited to the needs of a residential community where the ordinary factory type of construction would have been objectionable.

To further increase the good appearance of the plant a lawn is laid out in front of the office and the grounds are kept in attractive condition.

The plant covers a floor area of approximately

FIG. 1 NORTHEAST CORNER OF NEW G. A. GRAY PLANT WITH OFFICE IN LEFT FOREGROUND

FIG. 2 GENERAL VIEW OF THE INTERIOR, LOOKING WEST IN THE MAIN BAY

90,000 sq. ft. The main line of the Pennsylvania Railroad runs by the plant and sidings provide for the receipt and shipment of raw materials and freight. Three tracks run into the building, two toward the front and one at the rear. These tracks are depressed 4 ft. to bring the floor level of cars even with the floor of the plant for ready unloading and loading. Large wooden doors close these entrances. A tarvia roadway for auto trucks from the main street connects with two of the railroad entrances. Its surface is level with the tops of the rails to make truck operation easy. Down along the south side a 20-ft. concrete driveway runs.

The shop windows are all of steel sash. They extend almost to the roof and are fitted with 14 by 20 in. panes. The ratio of window area to wall area is 62 per cent and of window area to floor area 44 per cent. The three lowest rows of glass are clear so that employees may look out and avoid the feeling of restriction which attends the use of frosted or other opaque glass. Above the third row the glass is of the hammered ribbed type which admits abundant light without glare. Wood sash was used in the office, which fronts on the street, for better appearance and greater convenience.

The roof is supported upon steel framework and wood purlins. It is of the ordinary flat type and consists of Barrett specification 4-ply tar and paper on a 2-in. wood base. The center bay is higher than the two side bays and a monitor effect is thus obtained by use of steel sash down both sides above the roofs of the side bays. This monitor type was selected because it gives better ventilation, economy in drainage, fewer columns, possibility of operating cranes in side aisles, and elimination of dead light, which attend many types of saw-tooth construction.

The floor of the plant is constructed mainly of concrete. A great deal of the machinery is very heavy and requires strong foundations. Moreover, planer beds 80 ft. long have to be machined to almost a thousandth of an inch accuracy in the V-grooves, and consequently the floors must be level and not settle. As the ground on which the plant is built is filled in it would have been necessary to go down 30 ft. or more to reach a solid base for these machine and floor foundations. The expense of this kind of construction is very great and in order to avoid it a concrete mat to cover the entire heavy machinery floor was decided upon. This mat is 10 in. thick and is heavily reinforced by ⅜ in. rods at 6 in. centers running both lengthwise and crosswise of the shop and forming a networks at both the top and the bottom of the 10-in. concrete mat. In other places the floor is constructed of reinforced concrete 6 in. thick.

A large portion of the shop floor above this rein-

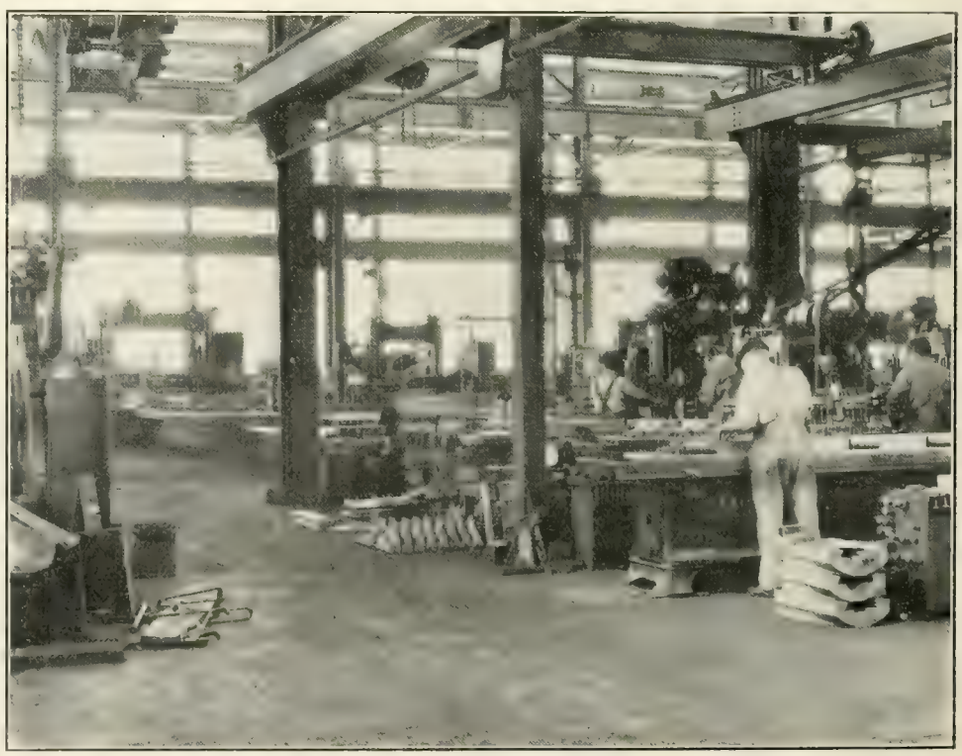


FIG. 3 A VIEW OF THE PLANER DEPARTMENT FROM THE SOUTH BAY

reced concrete is covered with wood block flooring 2½ in. thick and set on end. This flooring has great resilience and durability, is easy to stand and walk on and is less noisy than concrete.

As no dust or fumes are produced in manufacturing processes natural ventilation suffices for the shop.

FIG. 4 SMALL PARTS STOCK, WITH TOOL ROOM IN BACKGROUND

All of the windows are fitted with ventilating sections which are hand operated by bar and pin mechanisms in the lower portion of the sash and by a worm drive in the overhead portion. The office is equipped with ventilating fans.

FIG. 5 FITTING DEPARTMENT LOOKING NORTHEAST IN NORTH BAY

In order to intensify the natural illumination the factory walls have been painted with two coats of mill white paint.

Only two or three portions of the plant are partitioned off. The heating boilers are in a room in the northwest corner of the plant. Adjacent to this room is one forming the forge shop. Next to this are rooms for transformer, switchboard and rotary converter equipment. These three rooms are separated from the main plant by brick and tile walls extending to the roof. The foreman's mezzanine floor office, previously mentioned, is constructed of wood. The tool and stock room is enclosed in a partition composed in part of the backs of the steel shelving and in part by wire mesh on steel framework. In the office partitions are of brick and tile with plaster surface. Some of the partitions have the upper parts fitted with glass. On each floor there is a fireproof vault for the storage of records.

Special study was given to artificial lighting. In the main bay 500-watt clear Mazda C lamps with steel reflectors are used. Sockets are 32 ft. above the floor. In the north, or 50-ft., bay the same types of lamps and reflectors are used and the sockets are 26 ft. above the floor. Throughout the rest of the shop 150 and 200-watt lamps are used more closely spaced to increase the illumination. This lighting is all of the direct type.

In the lower office a direct system is used and in the engineering and production departments a semi-indirect system is employed. The intensity of lighting in the various localities is given in the following table:

| LOCATION | FT. CANDLES |
|---|---|
| Fine machines | 10 |
| Erecting floor | 6 |
| Planers | 6 |
| Turret lathes | 6 |
| Tool room | 10 |
| Stock storage | 4 |
| Office | 15 |

The plant is heated by steam generated in two industrial heating boilers. These operate under 6 lb. pressure and burn Pocahontas coal under natural draft from a 36-in. stack. The steam is piped to unit heaters, eight of which are located throughout the shop. These heaters consist of steam coils surrounded by a steel casing into which air is drawn from the shop by means of large fans. The air in the plant changes two and one-half times per hour, or makes a complete circulation every 23 minutes. This air is heated in

FIG. 6 SHIPPING DEPARTMENT IN NORTHEAST CORNER

passing over the coils and goes out at the top of the casing into the shop. A temperature of 65 deg. is maintained when the outside temperature is zero.

The office, toilets and washrooms are heated by wall type radiators supplied from the main heating system. The temperature maintained is 70 deg. when the outside temperature is zero.

The plant does not generate its own power but buys it from the Union Gas and Electric Company. Alternating current of 4150 volts comes in over the transmission line and is stepped down to 220 and 110 volts for use in various motors. About half of the current is passed through a rotary converter which changes it to direct current for cranes and variable speed motors.

An air compressor operating at 85 lb. line pressure is operated to supply power for pneumatic tools.

The plant gets its water supply from city mains. For drinking purpose this water is run through coolers located at convenient points around the shop. For fire protection service the water is piped to a 50,000 gal. tank carried on a steel framework tower at one side of the plant. This tank is constructed with a special elliptical bottom so that it can expand and contract without springing any joints. A 3 ft. riveted steel casing extends from the ground up to the bottom of the tank. This casing encloses the inlet and discharge water pipes connected to the tank, and also a 3-in. stream line to provide heat in the winter season so that the system will not freeze. It was formerly the custom to enclose these pipe lines in a wood casing and the tanks used ordinarily have hemispherical or flat bottoms which do not permit of much expansion. Consequently leaks were apt to develop and maintenance costs on the wood casing were very high. The equipment adopted for the Gray plant is greatly superior to this former method.

Most of the equipment manufactured consists of heavy parts and consequently overhead cranes of various types constitute the major portion of the material handling apparatus. In the main bay are two 20-ton electric traveling cranes with 5-ton auxiliary hook. In the 50-ft. bay there is one 15-ton electric traveling crane, prepared for 3-ton auxiliary hook. The 40-ft. sections of the other side bay are equipped with light traveling cranes the runways of which extend out into the main bay so that material can be delivered within reach of the large overhead cranes. Jib cranes are provided for local handling of heavy parts in the main bay. An electric lift truck with a complete equipment of lift platforms handles smaller parts to and from machines.

The storeroom and toolroom occupy a central position in the 100-ft. side bay. The equipment for this department was moved up from the old plant. It

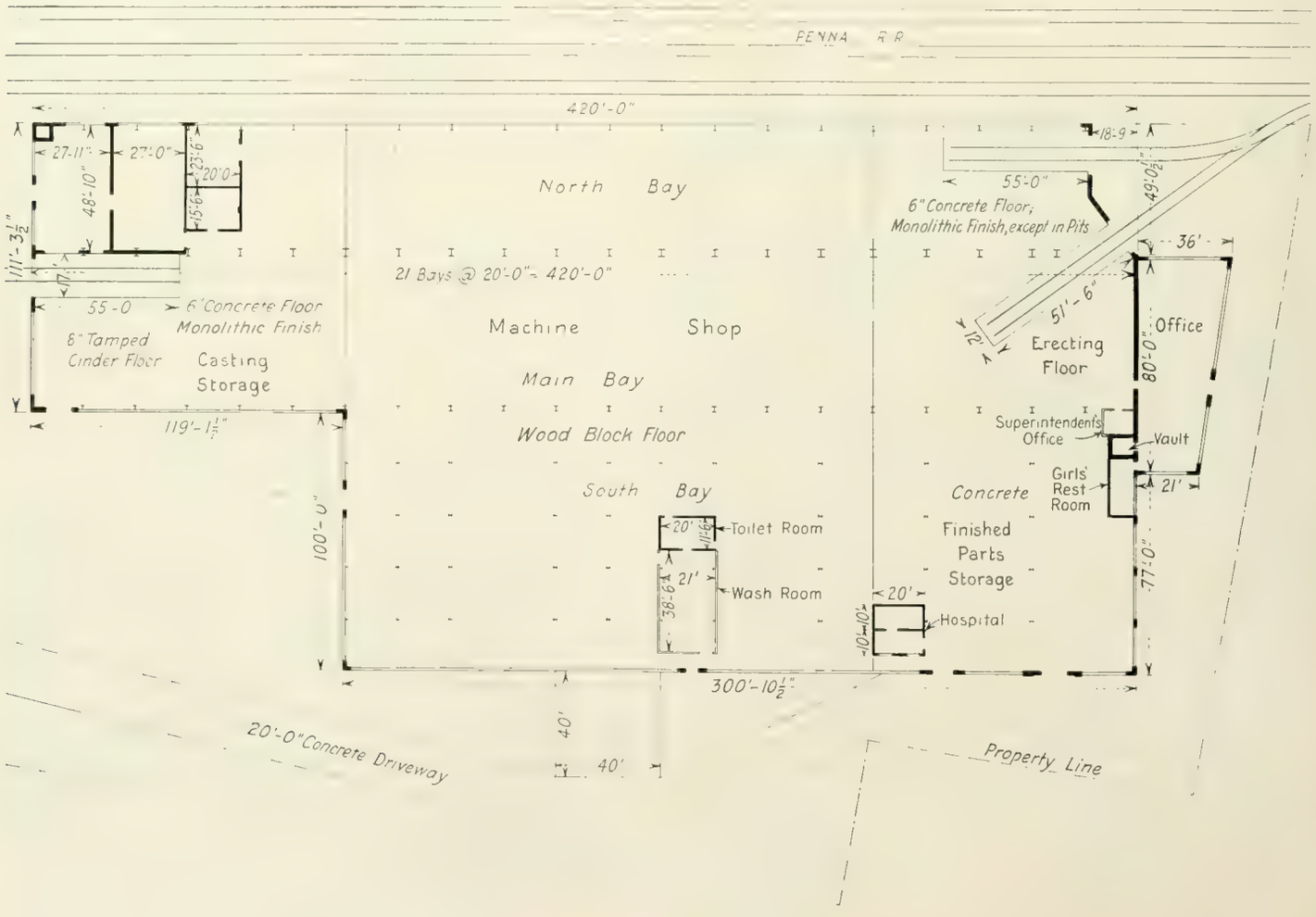



FIG. 7 GENERAL LAYOUT OF THE G. A. GRAY PLANT. BOILER ROOM, FORGE-SHOP AND POWER ROOMS IN UPPER LEFT CORNER

consists mainly of steel shelving with some wood shelving and bins which formed the original installation.

Dust collectors have been installed over a few of the processes, namely, buffing, polishing and dry grinding, and small rack cutting.

While the accident record of the plant is very low and no serious accidents have occurred for three or four years, yet a small hospital was deemed necessary when the plant was built. This was located in a small room toward one end of the 100-ft. bay, and regular equipment such as a couch, chairs, sterilizer, first aid cabinet, stretcher, etc., are installed.

Practically all of the mechanical equipment of the plant was moved up from the old building. As this equipment was modern and in excellent condition, an investment in entirely new apparatus would not have been justified. In a few instances special study of handling problems opened the way to eliminate equipment or simplify operations by special attention to plant layout. Thus the heavy planers are located so that they extend under both the 20-ton cranes in the main bay and the 15-ton crane in the 50-ft. bay. When a piece has been planed in the main bay the planer table can be run back into the side bay so that the part can be lifted off by the 15-ton crane and taken to a succeeding operation, and vice versa.

The plant was designed, erected and equipped by the Austin Company, of Cleveland, engineers and builders, working in co-operation with the engineering department of the Gray Company. The foundry is still at the old location and castings are delivered to the new shops by auto truck or railroad car. Later on, a foundry, planned along standardized lines, will be built at the new site, and the crane runways from the main bay will be extended into it so that heavy castings can be delivered from foundry to machine shop with but one handling.

TABLE I SUMMARY OF DATA ON G. A. GRAY PLANT

| | |
|---|---|
| Location | Cleveland, Ohio. |
| Construction | Concrete foundations, steel frame work, brick walls, steel sash throughout. Monitor. Ventilators. Blind. Brick walls with [illegible] floor. |
| Grounds | Lawn [illegible] |
| Property | Owned. |
| Building size | Main bay 60 x 420 x 44 ft. high. Small bay 50 x 420 x [illegible] ft. high. On the [illegible] 20 x 100 x 10 [illegible] ft. high [illegible] bay. [illegible] 2 high [illegible] high [illegible] |
| | On front is a two-story office building 80 ft. wide x 30 ft. deep x 24 ft. high. |
| Floor area | 90,000 sq. ft. |
| Architect | [illegible] |
| Number of floors | Ground floor. |
| Elevators | One [illegible] |
| Transportation facilities | Railroad [illegible] Pennsylvania Railroad. Tracks [illegible] the east, with roadbed on level with top of rails, to [illegible] |
| Entrances | Three for railroad cars—two at the east and one at the west end. One [illegible] boiler room and five from yard to shops. Railroad tracks [illegible] |
| Windows | Factory sash, steel projecting. Wired glass in [illegible] |
| Glass | 14 x 20 in. [illegible] Upper [illegible] Main [illegible] Plain glass. Prism [illegible] |
| Doors, exterior | Railroad entrances have large sweeping wooden doors. Smaller entrances and front entrance to office have wooden doors with upper panels of [illegible] |
| Doors, interior | [illegible] of wood. |
| Roof | Steel [illegible] |
| Ventilation | [illegible] |
| Walls | [illegible] |
| Painting | [illegible] |
| Flooring | [illegible] |
| Partitions | Southern Wood Preserving Co. [illegible] Brick and tile partitions [illegible] partment, and switch[illegible] Office partitions are either brick and tile with plaster [illegible] |
| Stairs | Concrete stairway with steel safety treads in office. One mezzanine floor. |
| Lighting | [illegible] enclosed steel reflectors, sockets 32 ft. above floor and [illegible] |
| Heating | [illegible] Nash Engineering Co. vacuum system operated by General Electric motor. |
| Pumps | [illegible] |
| Feed water heaters | Nash |
| Stokers | [illegible] |
| Piping system | 3-ply air cell. |
| Conveying system | [illegible] |
| Ash handling | Manual. |
| Power transformers | [illegible] volts a.c. Half is stepped down for use as 220-volt, 3-phase and 110-volt, single-phase current, and half passes through a General Electric synchronous converter, 220-volts, 880 amperes, 1200 r.p.m., to be converted into 110-volt d.c. for use on cranes and variable speed motors. General Electric switchboard and equipment. |
| Compressed air | Worthington single-stage compressor operating at 85 lb. [illegible] |
| Water system | City mains supply water at 125 lb. pressure. |
| Motors | [illegible] Small machines in south bay are belt-driven by overhead motors arranged for group drive. |
| Cranes and hoists | Two 20-ton, cage-operated cranes 23 ft. 6 in. under the hook in main bay, and one 15-ton, floor-operated crane 17 ft. under the hook in north bay, all Harnischfeger Corporation. [illegible] bay sections, with runways extending out into main bay to deliver planer parts within reach of 20-ton cranes. [illegible] in manufacturing are set to extend partly within main bay and partly within north bay, so that heavy castings machined in one bay can be run on the planer table into the other bay to be handled directly by crane without auxiliary transfer. |
| Electric trucks | One Automatic Transportation Co. truck, with numerous lift platforms, handles, smaller parts, cans of chips, etc. |
| Dust collectors | [illegible] |
| Sprinklers | [illegible] |
| Water tank | For fire protection, a 50,000 gal. tank with special elliptical [illegible] supply sprinkler system with city water. Made by [illegible] and 3-in. steam line. |
| Fire hose | [illegible] equipped with two hose lines each. |
| Fire alarms | City alarm outside plant. |
| Watchmen's system | Installed by Walnut Hills District Telegraph Co. |
| Storage system | Moved from former plant. Original installation was of wood. Most of the shelving is newer, and is of steel. [illegible] |
| Storage racks | [illegible] |
| Benches | Wood with cast iron legs. |
| Stools | [illegible] |
| Electric outlets | [illegible] units on machines. |
| Work tables | [illegible] |
| Chairs | [illegible] |
| Cuspidors | [illegible] celain. |
| Urinals | Vitrified porcelain. |
| Lavatories | [illegible] |
| Toilets | [illegible] |
| Drinking fountains | [illegible] |
| Plant communication | [illegible] |
| Telephones | [illegible] |
| Hospital | [illegible] |
| First aid equipment | [illegible] |

# Getting the Right "Slant" from Charts

By J. B. CONWAY

*The Fulton Company*

THE practice of using graphic charts in business was borrowed to a large extent from the system of engineers who represent engineering formulas by this method. It should be remembered that the great mass of engineering formulas is rather different than the usual data dealt with in business statistics. With the former a starting line or "zero" is essential for the correct reading and interpretation of most engineering data; with the latter the inclusion of this line is not always essential to the correct interpretation of statistics. At least, this is the inference one would draw from observation of the numerous charts that are published and in their final form have the base line omitted. There is, however, a reason for this.

At the time the writer began the construction of graphical charts for industrial purposes, some 12 years ago, there was not available the wealth of literature on this subject that exists today. Having had considerable drafting department training, it was but natural that in the construction of those first charts for industrial statistics the practice established by the engineers should be employed. Since that time the writer has constructed numerous charts, both historical and calculating, and does not recall an instance where the omission of the base line was questioned.

This line is essential in construction but in some instances it is permissible to eliminate it from the finished charts as in the following case cited by Lucian W. Chaney.[1]

> Suppose the smallest magnitude in a given group be 75 and a larger magnitude 100. It would then be in accord with common practice to cut away the lower portion of the scale to, say, 70. He continues, "the ocular comparison of the two magnitudes will now, of necessity, be that between 5 and 30 and not between 75 and 100. The chart then becomes not only useless but positively deceptive. Furthermore, when the series of magnitudes or number of lines becomes increased beyond two it becomes difficult, if not impossible, to compare the distances even though the entire scale be given. If this is further complicated by an abbreviated scale the situation becomes one of obscurity multiplied by deception."

## Executive Is Interested in Results

Now, in reality, does the executive observe this axiom? He is vitally interested in visible results. The results of today are compared with those of yesterday, last week, a month or a year ago. His interest lies in the progress or decline from some former record. When he inspects a graphic chart his attention is more likely to be directed, (1) to the changes in the points of the curve and, (2) to the values of these as represented by the scale at the left of the chart, rather than to a comparison of the changes relative to their height from the base or line of origin.

To illustrate: Let us say that the chart showed a reduction in sales from $200,000 one month to $175,000 the succeeding month, or that expenses increased from $15,000 to $20,000. He sees this change indicated, first by the movement of the curve, afterward in the values read from the scale. The curve is the signal that progress or retrogress was made and the numerical values indicate the present level, while the difference between the former and present level is shown by the slope of the line of the curve. This is sufficient for his practical purpose for he knows at once that conditions are favorable, or otherwise, and, it is a safe assumption, based upon actual observation, that the executive will not take the time or trouble to concern himself with the fact that the position of the point on the curve is at a certain distance from the base line, or whether the line exists on the chart.

## Relationships Indicated by Slope of Line

If the curve is plotted on co-ordinate ruled paper the slope of the line in the curve indicates only the arithmetic difference between the two levels; if on semi-logarithmic paper the percentage relationship. This latter fact is advanced as a reason why semi-logarithmic paper should be employed in preference to the former in some instances. While this is true, the same fact fact prompts the question, "from the great mass of graphically presented business data how many of these charts show the executive the exact percentage of change"? In the final analysis he must resort to figures to obtain these ratios.

If his interest lies in changes over a long period of time, say several years, his attention is directed to the change in levels and again he is not concerned so much with the base line as with the deviation, up or down, from some previously established record. For a comparison of this nature it is submitted that the base line is helpful in promoting a better perspective of actual conditions, it does emphasize the magnitude of the change. But is it really considered in interpreting the graph?

The statements in the quotations referred to above are incontestable from the viewpoint of the statistician and the engineer, and for the guidance of students of such subjects when constructing charts. On the other hand, the executive for whom business charts are made quite often knows little or nothing about the technique of their construction and, therefore, will not view it from the same angle nor employ the same interpretative methods that are used by the technician. If he does not understand the importance of including the base line for comparative purposes he is likely to render decisions based upon erroneous impressions received from the chart.

[1] Monthly Labor Review, March, 1919, pp. 24 and 25

# Pricing for Profit vs. Pricing for Volume

## Danger of Increasing Sales Volume to Point of No Profit

By W. L. CHURCHILL

THE continuous striving of manufacturers to obtain a greater and greater volume of sales, often producing more than the immediate market can absorb, is one of the primary causes for the low average of profits obtained in manufacturing industries. Even with products that cannot be made until sold, it is the hope and expectation of too many manufacturers, that, by quoting attractive prices, they will quickly build up a volume of sales and production that will make the attractive prices yield attractive profits.[1]

When the product is supplying a market that is growing as rapidly as the productive capacity, this speculation on the prospective growth of demand works out favorably to all concerned. Because it works out well under favorable conditions, many manufacturers believe that it will always work out well. On this belief, or assumption, or simply from habit, prices are made on a basis of the profits they will bring if and when enough product is sold to operate continuously to some abnormal capacity.

Frequently sales do not materialize in sufficient volume to enable continuous capacity operation, prices are still further reduced, costs are pared down to the bone, and the manufacturers stagger through the year with a profit so narrow that the keeping of one high grade clerk, foreman or salesman more than needed would wipe it all out for over 70 per cent of them.

### Manufacturing Profits Are Small

More than 150,000 American manufacturers sell their products at prices that leave profits so small that only by neglect of essential and necessary improvements in product, equipment, methods, personnel, salaries and wages can they pull through without loss.

A large proportion of the more successful manufacturers find their returns far from satisfactory, even though they consistently pay dividends of a sort to their owners or stockholders. As a rule these more successful concerns (unless producing some protected monopoly) operate with exceptional efficiency, but obtain only ordinary, or less than ordinary, returns for their exceptional operating ability. The principal reason for the unsatisfactory showing of exceptionally well managed manufacturing enterprises is the low prices at which their products must be sold to hold a reasonable share of business from going to less efficient, volume-hungry competitors.

There are very few lines of manufacture today for which the productive capacity is not greatly in excess of requirements, even when operated on a normal basis of a single shift. Except for industries requiring continuous operation on account of the nature of the manufacturing processes, we have equipment and facilities that by operating overtime, or on a basis of two or even three shifts, can multiply production considerably beyond any normal trade requirement whenever called upon to do so. The only operating necessities are additional man power and materials.

The World War amply demonstrated this fact, and gave experience that enables us to meet even more quickly any temporary or permanent increases in demand for almost any manufactured commodity for which materials are to be had.

### The Urge to "Get Business"

All too often manufacturers look upon their latent and unused producing capacity as something that must be utilized productively. A perfectly natural and justified abhorrence of waste, spurs them to an endeavor to eliminate the waste of potential producing capacity represented by idle equipment and buildings. Further, they may be spurred to efforts for sales volume by lack of satisfactory profits and dissatisfaction of stockholders who may attribute this condition to the apparent lack of sales effort to fill their plant with business.

"Get business! fill the plant with orders! run night and day! that's the way to make money!" So away they go with resolute enthusiasm to get the business. They get new business if they can, but get it away from competitors if they have to. Down go prices, some additional business is secured chiefly by the offering of prices lower than customers had been paying to others. The latter come back on a "meet price" basis. A merry price war is on, and it is only a question of time before the enthusiasts discover that they have no monopoly on low price quotations, and can not permanently fill their plant with work as com-

[1] See former articles on [illegible] pp. 97-100, and [illegible] pp. 175-178.

petitors are just "foolish" enough not only to meet the prices but often "go them one better."

It is not unusual for the offending parties to accuse the followers of violating all rules of fair play in not permitting them to carry out their program as planned. "They can't possibly produce as cheap as we can, as we run night and day and they have only one shift," is a common assertion of those who feel they have rights that others have not.

### Low Price Not Always a Remedy

The trouble lies in failure to understand that low price does not always increase consumption. It often merely shifts the trade around from one manufacturer to another, at a terrific cost to the industry as a whole and eventually to the public. With many secondary manufacturers this fact should be perfectly obvious but rarely is. A manufacturer of shoe nails cannot hope to stimulate consumption by reducing his prices. Consumption is dependent upon the shoemaker. They may stock up in advance of future requirements when low prices are quoted, but only to defer subsequent buying over a longer period. Likewise, the producers of a vast variety of our primary products as paper, steel, leather, fabrics, etc., depend chiefly, or entirely, upon their conversion by other manufacturers into commodities sold to dealers or consumers.

Many of these products would have just as great sale if no effort whatever was put forth to sell them. They would sell just as readily at prices that would be fair to the producers as at the reduced prices offered.

Not all efforts to induce sales volume is conducted on a basis of low prices. Often the manufacturer adheres to what he considers an already established minimum price but puts on an aggressive sales campaign to increase the volume of sales. The campaigns are not always successful, because of the fundamental weakness that they depend too largely upon taking customers from other manufacturers.

The same amount of effort given to obtain fair prices for what is being sold will often bring the desired profits without antagonizing competitors.

### Price Increase Better Than Volume

Commodities having a large proportion of material cost, require but slight advance in sales price to insure substantial increase in profit, even if a considerable drop in volume occurs. For example: A manufacturer of poultry feed may be turning out 5000 tons per month, but at no profit. He figures that by increasing 50 per cent to 7500 tons per month he will net $150,000 per year or $1.66 per ton. But raising the price only $3.14 per ton would bring the same net profit even if sales fell off 20 per cent because of price increases. As such an increase is less than 10 per cent, there should be little difficulty in holding established trade.

Few manufacturers have a definite knowledge as to what shrinkage in sales volume they can stand if they adhere to fair prices. The bigger the volume at unprofitable returns the more the drop before profits cease.

Manufacturers running 24 hours in an effort to earn ordinary profits may find that a slight increase in prices and rigid adherence to them will bring all the profit with only normal operations that their hectic activity was aimed at.

Most lines of manufacture have their normal average market which is well under full operating capacity. Few industries average year after year more than two-thirds their normal capacity. Some seasonal industries average to operate only 40 per cent or less of their normal capacity. Unless they can earn a normal profit when operating at the normal proportion of their capacity, reducing prices, to get more than a normal share, will not bring this profit except temporarily.

### Volume Depends on Activity of Industry

A concern that should earn $100,000 net per year, operating at two-thirds its capacity, will simply earn less than $100,000 if it reduces prices to get more than this share of business, when the entire industry can only utilize two-thirds of its capacity in supplying the demand for its products.

Every manufacturer needs to know what proportion of his capacity must earn his normal profit. He can only know this when he has knowledge of what the industry as a whole may be doing. It is not always possible or practicable to obtain reliable information from all manufacturers in an industry as to their production, sales and capacity, but usually a substantial proportion of the members will furnish sufficient information to be representative. When the United States Steel Corporation reports that for six years it operated at 66.6 per cent of capacity, it is a reasonable assumption that this represents the normal production of the entire steel industry.

The constant efforts toward increasing output per production unit tends always to make capacity in excess of readily available market. It is quite a common occurrence for manufacturers to develop methods, processes or equipment that will suddenly increase their capacity to an extent demanding 50 per cent or more additional sales if the additions or improvements are to be utilized.

The usual assumption is: All that is necessary to get this additional business is to reduce the price coincident with the reduction in cost. Instead of giving stockholders and owners even temporary benefit of the experimental and development work that resulted so favorably, prices are immediately reduced and arrangements made to operate on the greater production basis.

### Stealing Customers Is Folly

If the product is one that is supplying an already saturated market the only possible way to get the increase in business desired is to take other manufacturers' customers. This is not long permitted. In sheer self-preservation competitors are forced to hold

their established trade, and so they "meet" the new prices and strive to develop equally low production costs. As a result the industry in a short time has a tremendous excess of producing capacity and no one in it is making satisfactory profits.

The reason back of such action is the desire to produce volume. The desire originally developed to increase profits has become so obscured in the consciousness of the average manufacturer that he thinks volume rather than profits. A typical example was the recent development of a method for increasing the yield of one plant from 12,000 to 19,000 units from the same equipment.

Here was an increase of well over 50 per cent in productive capacity requiring only the sales to utilize it. As the concern was not making fair profits this improvement was hailed as a great money-maker because it would enable the firm to sell nearly 60 per cent more goods. It was already operating 24 hours per day. Prices were reduced to levels that would earn fair profits if the additional business was secured. It never was secured. Competitors quickly adopted the same methods; several of them with still greater increases in capacity. All prices slipped down to the lower levels thus established, so that the business is in a very precarious condition.

Progressiveness is liable to be disastrous unless there is a realization that a profit must be earned on the available sales volume.

### Too Rapid Development Invites Disaster

Some of our most prominent national industries have suffered complete financial revamping chiefly because the rapid development of product quickly overtook the possible market.

We read and hear a great deal about "waste in industry" and the enormous cost for distribution of manufactured products. But rarely do we read or hear of "price-cutting" considered as a waste, or an unnecessary addition to our costs of distribution. Yet it is one of the greatest elements of industrial waste and one that can be most readily eliminated. An understanding of its insidiousness will bring about its correction.

There are three major controllable elements entering into the prices of manufactured products: 1. Cost of conversion. 2. Cost of selling and administration. 3. Profit.

There is a fourth element over which the manufacturer has little or no control, namely, the cost of materials.

An ideal apportionment of selling prices based on normal production consists of materials at market price to which is added conversion cost, selling and administration costs and profit in approximately equal parts. Thus in a business requiring $100,000 per year for total manufacturing costs (less materials) there would be $100,000 for selling and administration costs and $100,000 net profit.

The total sales would approximate $300,000 plus cost of materials used. If $200,000 worth of materials were used total sales would approximate $500,000. If materials were $700,000 the sales would be $1,000,000, etc. If manufacturing costs are below normal there is just that much more to be added to profit or that can be added to selling cost and still retain normal profit. If selling and administration costs are less than there should be just that much more profit.

### Confusing Element in Prices

The confusing element in prices even when there is a definite profit figure arrived at (which is unusual) is what constitutes selling costs. Most manufacturers will agree that discounts taken by customers and allowances to customers for damaged goods, etc., are a part of selling costs. Very few ever consider that any cut from fair selling price should be charged to cost of sales.

Then there is a difference between selling expense and selling cost. Sacrifices from proper prices are a part of selling cost and should be so considered. When they are treated as cost many supposedly economically operated sales divisions show that they are quite the reverse.

Six manufacturers whose selling expenses were under joint review showed variations between 35 and 110 per cent of the conversion cost of their products. The 35 per cent manufacturer was congratulating himself over the low cost of this department as compared with his competitors, and argued that it explained why he could sell lower than any of them. The 110 per cent manufacturer was chagrined to learn that it cost him over three times as much to sell his products as it did the other firm.

When the complete facts were disclosed and the price sacrifices added to costs the 35 per cent firm showed a selling cost of 160 per cent as against 150 per cent for the 110 per cent firm. The low selling expense firm had specialized on large contract business and made price concessions in excess of its competitors to get this volume. The profits were consequently less than those of the high selling expense firm whose selling costs, although excessive, were less than competitors, who in their eagerness for volume sacrificed profits to enable them to run double shifts. The price of volume was reduced profits.

### Unknown Volume Sales Costs

Some firms carefully classify their costs for selling different sizes of accounts and, because of lower expenses per unit sold to large consumers, quote lower than standard prices but fail to add this sacrifice in arriving at a true selling cost. As a consequence they rarely know what it costs to obtain volume sales.

Developments in the art of salesmanship have been many. Complex and elaborate selling plans have been evolved to break down sales resistance and to encourage consumption of innumerable products. The call for salesmen, sales managers, advertising specialists and distributors of all kinds is so great that the re-

wards for competence in these positions average much higher than for producers.

This situation makes it comparatively easy for anyone with plausible sales plans to get a hearing, and vast amounts are spent in test and experiment. This item, however, is the smallest part of the selling cost aimed to increase production, as the greatest element of cost is unintelligent pricing. Goods priced in excess of their real value cannot obtain and retain a large market. Goods priced below their real values are bound to lose money for their producers regardless of volume.

### A Soap Manufacturer's Experience

A manufacturer of soaps had developed a fine grade that he was ambitious to exploit nationally. The soap had all the qualities of a famous brand and according to his figures he could sell to retailers for $0.05, a cake two-thirds the size of the popular $0.10 established brand.

An advertising firm was called in and a national advertising campaign prepared to put the new soap over in a big way. The soap was given an attractive name and trade-mark, posters were designed and lithographs made, and advertising copy developed.

When the campaign preparations had nearly reached completion the advertising firm suggested that a soap powder developed by the firm could very profitably be exploited along with the soap. The manufacturer said, "No use, I can't make soap powder cheap enough to compete with other large producers." It was suggested that he get an engineer to study his methods and see if manufacturing costs could be reduced sufficiently to enable the soap powder to be marketed in competition with national brands.

The engineer's first move was to study the costs of the various steps in soap powder production. These proved to be so much lower than those calculated by the manufacturer that he also investigated the costs of the proposed $0.05 cake of high-grade soap. This was found to be very much greater than had been indicated by the manufacturer's cost system and the discovery brought about abandonment of the selling campaign planned. There is little doubt but what the proposed campaign would have brought a sufficient volume of sales to have wrecked the firm.

### Manufacturers Must Protect Themselves

Manufacturers cannot look to customers to protect them against their own errors in pricing. As a rule these errors are of an insidious nature that sometimes take years to effect their ultimate damage. Volume grows and possibly total profits increase slightly, but profit ratio lessens year by year and gradually total profit lessens until it is eventually wiped out, even with increasing sales volume and often because of this increase in volume.

With a varied line of products or even with but a few grades or sizes of a few products there is often some one or a few items that prove attractive to certain large buyers. Because of their large buying capacity they are given extra price concessions, and sales volume increases as these buyers' purchases grow. Profits, however, do not always increase with this increase in volume, but the manufacturer is apt to be so complacent over the fact that he has this big outlet that he refuses to even think of the possibility of it being unprofitable. He goes blithely on building up this pet account or line for the volume it brings him and blames the nature of the business for any lessening of profits.

A typical case is that of a manufacturer of kitchenware who developed a line for the 10-cent store trade that in a period of 8 years grew to $250,000 a year in his total of $2,000,000 of business. At this point his profits had already ceased although, when the line was introduced, he was making $150,000 net on $1,000,000 of total business.

An investigation disclosed that the 10-cent line, although grossing only 12.5 per cent of sales was using 40 per cent of the manufacturing effort. When their pricing methods were investigated it was found that this line should have brought $400,000 and that, therefore, it had lost $150,000 of net profits per year.

Other lines had been developed for other large buyers (notably mail-order houses) that had caused additional losses. The combined effects of the losing lines developed to build up volume had increased sales 100 per cent, increased personnel 150 per cent and wiped out profits.

At the time these goods were being sold at a loss, many items manufactured were sold at an excessive profit. Unintentionally, due to faulty pricing principles, quality goods had been priced so high that sales were very small and the impression developed that quality goods had a very limited market. Volume had to be built up on cheap goods. It was built very successfully but at the sacrifice of profits.

### Remedy for Pricing for Volume

The remedy is simple enough. Education in the principles and fundamentals of "pricing for profit" as against "pricing for volume."

When manufacturers associations tackle this problem of educating the heads of their member firms in sound pricing practice they will at once eliminate the supposed necessity for price agreements. There is ample business in normal times for all worthy manufacturers to make normal profits if they only keep pace with the natural growth in production demand. Trying to force added consumption by artificially depressed prices only results in ultimately increased cost to consumers. This is brought about through two major channels:

1. By increased selling expense due to too many manufacturers trying to divert business from others to themselves.

2. By higher price standards necessary to insure average profits over periods of years in which violent competition forces low profits or actual losses.

# Maintaining Hourly Control of Production

## How the World's Largest All-Steel Automobile Body Plant Regulates Manufacturing Operations

By GEORGE G. BROOKE

[illegible]

THE system herein described is the actual operating method of production control used by the Edward G. Budd Manufacturing Company, the largest manufacturers of "all-steel" automobile bodies in the world. In a previous article,[1] the material handling methods of the plant were described. In the course of this article, it was explained that the plant was engaged in building all-steel bodies for automobiles on a mass production basis, and that open and closed models were made for many of the leading automobile manufacturers in both America and Europe. With this brief description of our product and our scope, we will confine the rest of this article to a description of the physical control of material for production and the measure of its effectiveness as reflected by the cost records.

A separate assembly department is maintained for each model, but the press shop, with its expensive equipment, must be used interchangeably for the work of all customers. In view of this, the material control problem is somewhat complicated, due to the necessity of operating by means of a "continuous" process system instead of a "job order" process system. The latter system affords the opportunity of inventory checks and attendant adjustments at the completion of each order, while the former offers no such opportunity, there being no break in production.

The press shop and assembly department are each controlled by a superintendent and each superintendent reports directly to the works manager. The planning department, also directly under the works manager, co-ordinates production from the steel storage sheds to the shipping platform, and it is with this department in particular that our article deals.

### Planning Department Divided Into Two Groups

For functional purposes the planning department is divided into two major groups, operating and statistical, and they function as their names imply. Each of these groups, in turn, is subdivided into smaller groups as indicated by the organization chart in Fig. 1.

1. *Stenographic.* The stenographic group handles the usual inter-office correspondence, report, etc., and requires no further explanation.

2. *Book Records.* When an order is received from the sales department, it is broken down into its component parts in accordance with the parts list for that particular job and entered in the order column on the production books. A separate sheet is maintained for each piece involved and each successive order is added to the succeeding total so that a cumulative total quantity on order is maintained for each piece. In many instances, a given piece is common to more than one model, in which case all the orders affecting that piece are entered on the one sheet and accumulated.

Before a run goes to the shop, it must be OK'd by the record clerk, who is charged with the definite responsibility of passing runs with respect to the amount on order. There is no condition which will justify him in OK'ing a run in excess of orders, and he must not

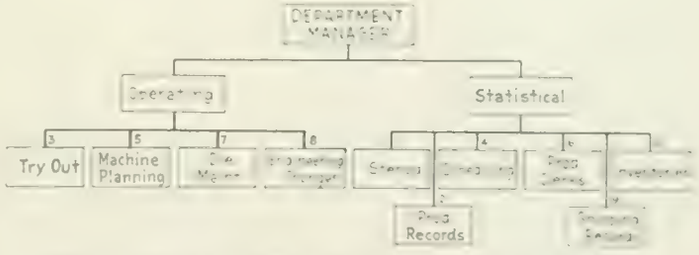



Fig. 1 Planning Department Organization Chart

allow more than one run of the same piece in the shop at any one time, unless OK'd by his supervisor. As each run is finished it is ruled off separately and added to the preceding total, thereby obtaining a cumulative total produced. Pieces spoiled in operation are posted currently as a deduction to the total quantity produced.

3. *Die Try-Outs.* Before a new job goes into production, a complete set of dies must be built. Each die must be tried out before it is OK'd for production, and for this purpose short try-out runs are issued, usually for 100 pieces. It is the duty of this group to work with the machine shop and ascertain the date each die will be completed, to arrange with the planning group for the type presses needed and to record the result of the try-out. As the dies are OK'd, regular production runs are scheduled.

4. *Scheduling.* Although we may have an open order for 20,000 sedans, the customer doesn't want

[1] See December 1925 issue, pp. 221-324, "Material Handling Methods in the Edward G. Budd Plant," by W. A. Graf.

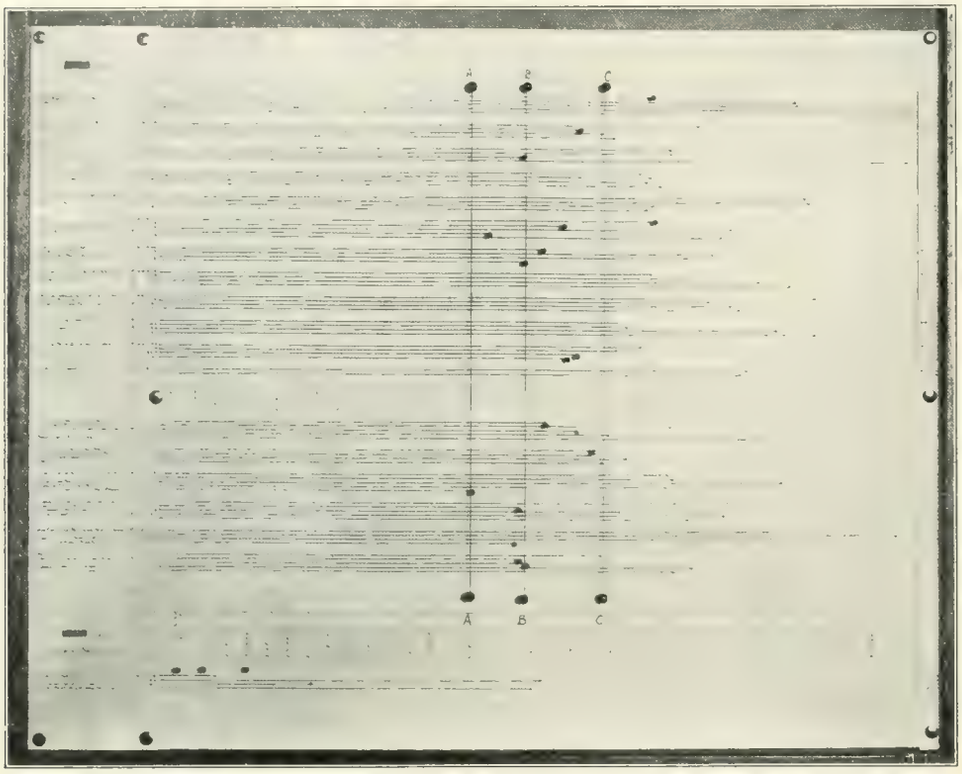


FIG. 2 PRODUCTION CHART WITH HORIZONTALLY MOVABLE STRINGS—SEDAN BODIES

them all at once. We must ship a certain quantity each day and, based on the customer's requirements, the works manager's office issues formal releases against orders on a daily basis. These releases are sub-divided by the planning department into convenient size runs for the shop to make and store, usually a 20-day supply, which is our operating cycle as determined by a study and analysis of press capacity.

For example, if the customer requires 100 per day, the schedule clerk sends runs to the shop for $20 \times 100$, or 2000.

All scheduling is done through the medium of movable string charts which automatically signal the schedule clerk. See Figs. 2 and 3. Each string is endless and passes over a roller at each end and back along the rear side of the chart. Half of the string is black and half is white. The black portion indicates the chart reading by the distance it extends horizontally from the left, after the manner of the Gantt chart. The white portion is almost invisible.

A large, specially built cabinet is used to house these charts. Each job is grouped into the pieces used on one job (sedan) only, a separate group for sedan and coupe, another for sedan, coupe and roadster, etc., and the production on each piece is shown in terms of jobs, so that it makes no difference whether we use one piece, two, three, or four pieces for each job.

As a run is completed in the press shop, the final operation card goes to the record clerk where it is entered. On the back of this card the record clerk adds the total of the current run to the cumulative total (less all spoilage), thereby arriving at the new cumulative total, which is entered in the books. The card is then sent to the chart operator who moves his production string for that piece horizontally to agree.

You will notice three vertical strings cutting the production lines of each piece. The left string (A) denotes shipping, which, of course, must be the same for each piece in an assembled unit. This string is moved to the right each morning in accordance with the previous day's shipping. The middle string (B) is also moved each morning so that it is always five days ahead of shipping. This represents a five-day bank of material in the assembly department in various stages of sub-assembly. The third vertical string (C) is set seven days ahead of (B) and represents the schedule point. This allows five days for the press shop to make the stamping, and two days for the routine of making out the operation cards, having them OK'd for orders, for steel and for dies and for getting the run to the

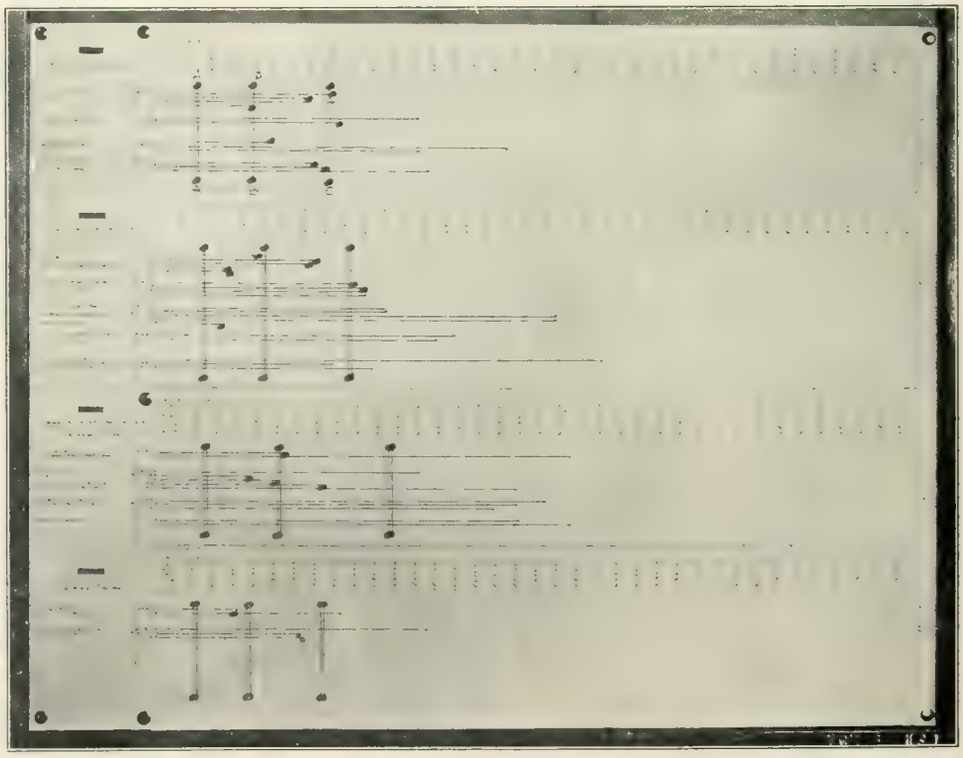


FIG. 3 PRODUCTION CHART FOR SEVERAL DIFFERENT TYPES OF BODIES

shop. Each day as this string is moved to the right, the ends of certain black strings are touched and the chart operator makes a list of them for the schedule clerk.

As the schedule clerk releases the run to the shop, the chart operator inserts a black pin opposite that piece, while if the run is held for steel, or if one of the dies is in the machine shop for repairs, he inserts a red pin. As a result, a glance at the chart any hour of the day will show exactly the status of the whole job as well as of any individual piece with respect to shipping and to the sub-assemblies. It automatically signals the pieces which must be expedited and it keeps an even flow of work to the shop, in addition to providing an automatic scheduling device.

An order-of-work statement is made from the chart each week for every job, showing the pieces in the order needed on the assembly floors, together with the date needed. These statements are the active guides of the machine lay-out men and of the die maintenance group and govern the order of work in the shop.

The central planning office maintains a master route file, Fig. 4, for each individual piece, which contains a description of the piece, the operations in their proper sequence, number of the die which performs the

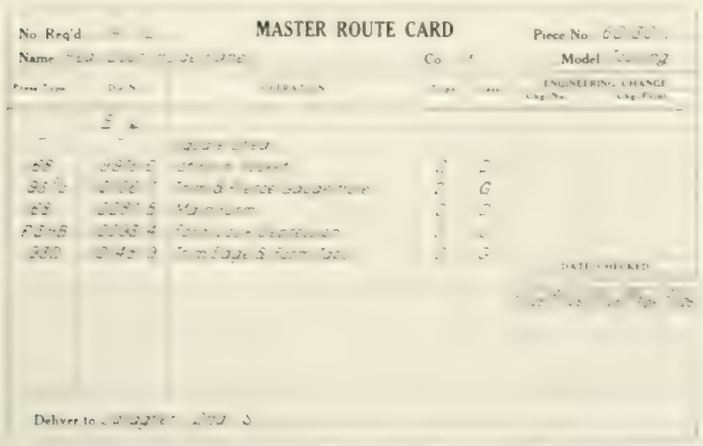



FIG. 4. MASTER CARD TO CONTROL JOBS

operation and the type press for which the die was designed.

When the schedule clerk receives his list from the chart operator each morning, he makes up a shop card, Fig. 5, from the master card, determines the quantity needed (20 days' supply times daily requirements), and then makes an individual operation card, Fig. 6, for each operation.

The upper half of the operation card constitutes the production card on which a record of the run is kept, while the lower part is used by the foreman and inspector to record the condition of the die for maintenance purposes. These are clipped together and sent to the shop office along with the steel requisition. As machine line-up men assign the jobs to particular presses, the desk clerk sends the operation card to the press and the production clerks record the quantity finished.

5. *Machine Assignments.* Assigning work to the various machines is the function of the planning group. These men must have an intimate knowledge of the peculiarities of each individual piece, each die and each machine, and must bear in mind the location of the presses involved in order to minimize internal trucking. Using the order-of-work statement as a

FIG. 5. SHOP CARD ATTACHED TO PRODUCTION

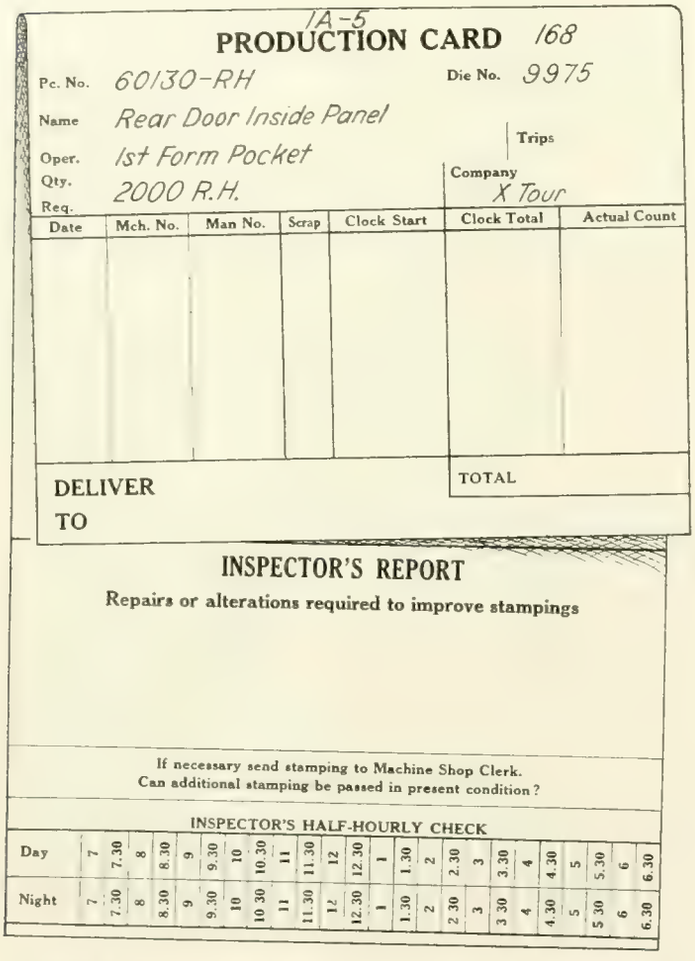
guide, the planning men assign the work through the medium of a card showing the piece number, die number and operation name. The die setter uses this card as a requisition on the die storage department and obtains the proper die, which he then proceeds to set.

6. *Production Clerks.* While the die is being set, the production clerk obtains the operation card, Fig. 6, from the shop office and places it on the press. Each press is equipped with an automatic counter, which is unlocked with a key. He sets the counter at zero, and fills in the press number and operator's number on the operation card. This card, previously made out at the schedule desk, contains the necessary instructions for the operator as to quantity needed. If an engineering change is pending, or a change in model is contemplated, a stamp across the face of the card warns him that he must obtain the full quantity specified, but that he must not overrun that amount. Delivery destinations as instructions to the truckers are also shown on this card.

7. *Die Scheduling.* In the course of time, dies become worn, punches break, springs must be replaced, etc., which necessitates sending them to the machine shop for repairs. The condition of the die while it is on the press is noted by the inspector and the foreman on the duplicate part of the operation card. When a run is completed, the production clerk detaches this stub and sends it to the die scheduling section, using this information as instructions to the machine shop for the necessary repairs, and using the order-of-work statement to determine the date it will again be needed for production. This group follows the die, makes sure that the repairs are made and also makes sure that it is repaired in time for the next run.

8. *Engineering Changes.* During the life of a model, many minor changes are effected. A separate group

obtains advance information from the engineering department relative to the pieces affected, from which they determine the dies that must be changed and obtain the approximate length of time required by the machine shop to make the change. Then from the order-of-work statement they determine the standing of the job, whether we have sufficient stampings ahead to allow the machine shop to alter the dies at once, or whether another run must be made first. They



1A-5

**PRODUCTION CARD** 168

Pc. No. 60130-RH Die No. 9975

Name Rear Door Inside Panel

Oper. 1st Form Pocket Trips

Qty. Req. 2000 R.H. Company X Tour

| Date | Mch. No. | Man No. | Scrap | Clock Start | Clock Total | Actual Count |
|---|---|---|---|---|---|---|
| | | | | | | |

DELIVER TO

TOTAL

**INSPECTOR'S REPORT**

Repairs or alterations required to improve stampings

If necessary send stamping to Machine Shop Clerk.
Can additional stamping be passed in present condition?

INSPECTOR'S HALF-HOURLY CHECK

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | 7 | 7.30 | 8 | 8.30 | 9 | 9.30 | 10 | 10.30 | 11 | 11.30 | 12 | 12.30 | 1 | 1.30 | 2 | 2.30 | 3 | 3.30 | 4 | 4.30 | 5 | 5.30 | 6 | 6.30 |
| Night | 7 | 7.30 | 8 | 8.30 | 9 | 9.30 | 10 | 10.30 | 11 | 11.30 | 12 | 12.30 | 1 | 1.30 | 2 | 2.30 | 3 | 3.30 | 4 | 4.30 | 5 | 5.30 | 6 | 6.30 |

FIG. 6 PRODUCTION CARD FOR AN INDIVIDUAL OPERATION

A carbon copy is the Foreman's Card and the Inspector's Report is attached below.

then set the change point and notify all departments concerned, giving the change number, the pieces affected, the change point, and whether or not all pieces involved are to be evened up to make the change.

9. *Shipping Records.* A separate set of records is kept for each unit shipped. Each morning, shipper's reports showing all the material shipped the previous day are forwarded to the shipping record desk, in the central planning office. These shipments are applied against the proper orders. They are then sent to the billing department to be invoiced. Cumulative shipping figures as well as cumulative on-order figures are kept in these shipping records. The cumulative shipping figure on the left of the sheet in the shipping record, deducted from the cumulative on-order figure on the right of the same sheet, will determine just how many units are yet to be shipped and on which orders.

Periodic checks are made in order to keep the total on-order quantities equal in the shipping and production books.

A cumulative total produced for a given piece (from the production records) less the cumulative total bodies shipped (from the shipping records) will show the balance in process, and this, of course, is the basis of the scheduling charts previously explained.

10. *Inventories.* The central planning office maintains a material chaser, or inventory man, in each assembly department. He is charged with the definite responsibility of keeping that department supplied with material. As a guide, he is supplied with an order-of-work statement, and he is required to check his department each day, and report any instances wherein the floor and the statement do not agree. Such discrepancies are immediately investigated. In addition to this daily check, each of these men is supplied with an inventory schedule, which at present is worked on a six-month cycle. From this inventory list the checker selects a piece that is low in production, and physically counts his loose stampings, the sub-assemblies into which they enter, the major assemblies, and on through to the shipping platform, setting each count in its respective place on the inventory form, Fig. 7.

To this he adds the cumulative shipping total from the shipping records, thereby obtaining a physical inventory of the piece. For comparative purposes he also enters the production count on this form, and the increase or decrease measures the gain or loss suffered since the last inventory, usually a period of about six months. The following is evidence of the improvement in control from August 1923 to October 1925:

| DATE | NUMBER OF INVENTORIES TAKEN | AVERAGE LOSS PER INVENTORY |
|---|---|---|
| August 1923 | 132 | 847 |
| October 1925 | 403 | 37 |

Of course this record, which is compiled monthly, is based on averages. Small reinforcing pieces are considered the same as doors and tonneaus in arriving at these figures, and although the average loss of 37 pieces per inventory in October is used for the above comparison, it also represents an approximate average for the first ten months of the year, the maximum being 56 in July and the minimum 15 in September. The record reflects the effectiveness of the control, and an average improvement of 95 per cent in the average reduction of process inventory losses is well worth consideration by any plant, regardless of size. And it doesn't make any difference whether such losses are considered as physical losses, or merely as book losses. The result in either case is the same. First, the planning department cannot function efficiently if its figures are not reliable; and second, cost of sales has been understated, so that a fictitious operating profit

**Production Check**

Piece No. 60130-1 No. per Car 1 Each Date 10/16/25

Description Rear Door Inside Panel – X Tour

| | BOOK | INVENTORY R | INVENTORY L |
|---|---|---|---|
| Stampings | | 571 | 1122 |
| Inside Panel Operations | | 18 | 12 |
| Door Assemblies | | 224 | 316 |
| Passed Final Door Inspection | | 313 | 295 |
| Jig Assembly | | | |
| Shipped 10/15 Inclusive | | 36128 | 36128 |
| Total Produced | 37285-R 37901-L | 37254 | 37873 |
| Inspection Inc. | | | |
| Remarks: | | | |

FIG. 7 PRODUCTION CHECK FOR PERPETUAL PHYSICAL INVENTORY

is shown which must be reduced on the strength of the physical inventory loss.

Our production departments are tied in from the steel storage sheds through the cost records to the general ledger. In view of this, all requisitions for steel, when completed, are routed through the planning department for counts before they go to the cost department, in order that the accurate, automatic count at the machines may be used. A variation of three sheets of steel, each of which develops 10 blanks, would otherwise cause a discrepancy of 30 blanks between the two sets of records, and before the next inventory this may total 300 or 400 pieces which the cost department would have to adjust.

By applying the counts to all requisitions from the production records and by systematically inventorying each piece in accordince with a prearranged schedule, we are able to keep the cost records in balance with the physical condition in the shop at all times. This enables the cost department to reflect true operating costs as a guide to the management and eliminates the necessity of closing the plant for a week or more at the close of each fiscal year in order to take a physical process inventory, which practice almost invariably results in a vicious attack on the profit and loss account.

# Reorganizing a Run-Down Manufacturing Plant

By E. H. FISH

THERE are undoubtedly kinds of manufacture where the sales organization is so effective that it makes little difference whether the shop is producing efficiently or not. But most of us have to push production pretty hard or get along without dividends.

Anyone can speed up production to some extent by going out into the shop and bawling out two or three obvious loafers and firing another. But he gets nothing but a physical speeding up that lasts only a few days at the most.

Buying new production equipment is spectacular, but it usually takes a long time to get the money back unless the old equipment is very far behind the times. In that case the company probably has no money with which to re-equip. So it is pretty safe to say that wholesale re-equipment is not to be favored.

New systems of planning, routing, follow-up, and such, work wonders in shops where there is a multiplicity of detail, and where batches of parts of the product have a way of getting sidetracked or lost. They speed production by cutting down the detours. But they are not always a necessary corrective.

The man who tries to cure everything with a bonus on production gets remarkable results in shops where piece-rates have prevailed and where the workmen have been afraid to let out for fear their rates would be cut. He also gets results in almost any shop that has been on day-rates for years, enough so that an established daily task has crept in and become standardized. Under other conditions he may fail.

These observations are prompted by my own recent experience with a shop, which shall be nameless, whose owners have been pouring good money after bad for several years, until at last necessity forced them to find out what had become of it, and how much more it was going to take before profits began to come back. The story is that considerably upward to a quarter of a million had gone into the business, of which the firm's books showed about $30,000 left. My own observation and a reasonable scaling of inventory to something less like a fairy tale showed them bankrupt by about that same amount.

## How the Condition Came About

The condition found here is typical, though extreme, of many similar cases scattered in every direction. At the very peak of the highest prices back in 1919 and 1920 this shop was organized and equipped by a group of men who knew nothing about manufacturing, except that some of their friends had made a lot of money out of it. The business is, let us say, the manufacture of small interchangable parts such as press and screw machine products. It involves making dies and special tools, for which the customer is supposed to pay, and then the manufacture of large quantities of the products of those dies. The machinery that the company bought is the best, or at least the highest-priced machinery on the market. The shop building

is well adapted to the work, the location is in the middle of a field affording at least a million dollars worth of business, on which competitors have to pay quite substantial freight rates.

But—and there always is a "but" in these cases,—they could not make the product come out of the dies the shape and size that they expected. Man after man was hired to run the die-making part of the work, but the product was not usable. Finally some one came along who was good at blaming others, and he succeeded in diverting attention from the die shop to the manufacturing shop. Then for a long time they concentrated on production with the dies they had. By dint of much firing of help a few men were ultimately found who could get production with these dies. Now after five or six years they are able to ship some goods, say 50 per cent of what they make, with some hopes of getting the goods to stay sold.

The result of all this experimentation is that not only have the owners lost a lot of money, but they have very little except their equipment that is an asset. They have a lot of tools and dies, title to which rests with their customers, but which are bringing them no repeat orders because there can be no confidence in their delivery dates. They have had no money to keep their fine equipment in condition. It was built for delicate work. In the rush of trying to get out orders so as to meet payrolls, adjustments have been made with sledge hammers. The morale of the employees has been shot to pieces. Everyone knows that the firm cannot possibly have made any money. They have advertised that fact by using it as a reason for cutting salaries. The directing force has been cut down so that half the machines that should be running are standing still, while the operators stand around waiting for someone to decide what is to be done to get them going.

### Putting the Shop on Its Feet

What will have to be done to put such a shop on its feet? A lot of things. First of all, a definite stoppage of "remittance" money is necessary. Instead of putting more money in, let the management understand that beyond maintenance funds to keep the machinery in usable condition the only funds they can expect are those justified by orders on the books. There will have to be working capital of course, but prices should be sufficient to amply justify bank loans followed by the discount of trade acceptances.

Next a very definite policy should be adopted not to ship anything that is known to fall short of specifications. Any concern in this condition is under a great temptation to ship goods, hoping against hope that they will be so badly needed that they will be accepted. The inspector should be a man who doesn't care what anyone thinks, and he should be backed up by the highest official of the company.

Again, a definite policy of setting and living up to delivery dates should be followed. This means for the present the assumption that only half the product will be saleable, and deliveries should be promised accordingly.

Having put the firm in the way of acquiring the good will of its customers, let us look at the shop itself.

It is obvious that the equipment must be put in usable condition. Possibly some equipment should be traded for more rugged, if less expensive, machinery.

Someone should be put in charge of making tools and dies who has mechanical ingenuity and the ability to make deductions from past experience. It is futile to try to hire successful men from other shops. This plan has been tried without results too many times in the past. Every problem that comes to this shop is a new one, every new die involves the necessity of some experimenting, even if it is like some past die in everything but a few dimensions. These facts should be met squarely face to face when quotations are being made. If the customer will not pay the full price of the tools in a separate bill, they should come into the price for the first order. It is also necessary that the man in charge of tool making should be someone whose very personality will discourage buck-passing from the production department.

### Reorganizing the Production Department

Then the production department itself requires reorganization. We are now giving it good equipment and correct tools and dies. A production bonus, based on goods accepted not only by the inspector but also by the customer, ought to improve output and encourage the workmen. At present in this particular shop, there is a piece-rate system and a guaranteed day-rate, but no one dares to exceed the day-rate by more than $0.50 a day. So there is not much value in the piece-rate. Moreover, it is paid on goods shipped, good and bad together, and the bonus for a week's production seems therefore to be definite and fixed. Under present conditions in this shop men have been known to keep busy for days turning out product that they knew to be wrong, because if they stopped their machines they would be unmercifully bawled out, if not discharged, before they had a chance to explain.

But the largest gain, and the one that justifies trying to revive the concern, is the fact that just as soon as the workmen find that it is to their interest to do so, they unburden themselves of a vast amount of knowledge of the business that has remained and always would have remained hidden. These men have seen about everything tried, they have seen things that would have been successful if the experiment had only been continued a little longer. They know what the consequences are of doing this or that, but there has been no reason and no encouragement for them to tell anyone. Men who merely hope that the company will not go into bankruptcy until after the next pay day are not inclined to be very helpful. But show them that it means money in their pockets to tell what they know, and they surprise us with the material help that they give.

# Judging Operating Results

## Analysis of Operating Statements in the Financial and Industrial Investigation

By ARTHUR ANDERSEN

*Arthur Andersen & Co*

USUALLY an exhaustive analysis of a company's profit and loss statements over a period of years is necessary only in connection with financing. This may be preliminary to financing or may be called for because earnings after financing have not proven entirely satisfactory. Partial analyses of operations are sometimes made in connection with internal investigations, but are more frequently of a specialized nature and conducted to supplement the analysis of some operating problem. For the purpose of this discussion it will be assumed that the analyses of operations are being made in connection with financing of some nature.[1]

Such an analysis accomplishes two distinct results: it shows the actual performance of the company and the reasons for this performance; and it gives the basis for passing upon the soundness of management policies.

It is not sufficient that a business has shown satisfactory profits over a past period of years, for these profits might have been greatly increased were it not for elements of extravagance, lack of sales initiative, careless servicing, or what not. The profits earned may result from patent monopoly, natural advantages of material or labor supply or overwhelming demand, and actually the business may have succeeded financially in spite of poor management. Such a situation gives no assurance of future earnings and the existence of these conditions would be indicated by the profit and loss analysis.

### Earnings Requirements

Beyond all else it is necessary that the business show a demonstrated earning capacity, for capital has a value only in proportion to the return from its use. Return, of course, is gaged almost directly in proportion to the risk involved. The return on Federal and municipal securities is lower than the return on industrial bonds, which, in turn, is lower than the return expected from capital stock. If the type of enterprise is known, it is fairly easy to judge what should be the normal rate of return on the capital involved. Inversely, if the earnings of a business are known it is impossible to set up normal values for the various classes of stock that may have been issued.

[illegible] financing of the Dodge Bros. Motor Company, wherein the demonstrated [illegible] capitalization of intangibles in the amount of approximately $75 000 000

A prime essential in determining the form of the capital structure of the new corporation is that the business shall be able to earn an adequate return on the new capitalization. If no additional capital is involved the task is fairly easy, but if the introduction of additional capital is based upon the acquisition of new facilities and expansion over past operations, it will be necessary to make some very careful forecasts, even in the detail of a complete budget of operations, sometimes over a coming period of several years.

In the consideration of return on capital, it is necessary to consider more than the senior securities which may be offered to the public. Each business has a complete financial structure which, if well laid out, is carefully balanced in its proportions of funded debt and contributive capital. The business as a whole is sick if its earnings can do no more than care for its senior obligations. The market value of common stock may be seriously affected by the issuance of a large block of cumulative preferred stock, and too great an obligation for preferred stock may destroy the initiative of the active operating management if it has large holdings of the common.

It becomes important, therefore, to analyze the ratio of the earnings to the capitalization and the probable margin of safety, after taking care of the interest and dividend requirements and after meeting the sinking fund requirements on bonds or preferred stock.

### Determination of Profits

Back of any analysis which may be made, lie the operating statements which must be used by the investigator. Upon the accuracy, completeness and comparability of these statements for the period of years covered, rests the worth of the analytical conclusions. It is, therefore, essential that for the vital period of time these statements shall be the result of an audit or audits.

Normally it is desirable to have audited statements

[1] Former articles on [illegible] were published in December 1925 [illegible] January 1926 [illegible] 17-22, February 1926, [illegible] and March 1926, [illegible]

for each of the five years preceding the date of the investigation. Very often an interim audit must be made to cover the elapsed portion of the current year, so the statements may cover four years and six months, or four years and nine months. There may be cases where the corporation has been in existence for only two or three years, making it desirable to secure audited statements of the predecessor or component companies.

Even where audited statements are available for a five-year period it is often desirable and always helpful to draw off at least condensed statements from the company records for a prior 5, 10 or 15-year period, as permitting a study of long-time trends. These data are particularly valuable where the industry is one of extreme hazard or is subject to violent cyclic fluctuations.

This emphasis placed upon the use of audited statements is necessary for several reasons: Earnings must not only be accurate for the entire period considered as a unit; they must also be accurate for each one of the years covered by that period. It is essential that problems in connection with the appreciation or depreciation of fixed assets should be handled correctly and that the company's accounting procedures, in general, shall have been consistent from year to year. Unless inventories have been taken and priced on a single, consistent basis, it is probable that earnings have been distorted thereby as between years.

Unless the make-up of the accounts has been the same in each year and there has been a correct allocation as between capital and expense accounts, earnings may not only have been shifted as between years, but may also be appreciably over or under stated. Unless depreciation has been charged off on a uniform basis each year the earnings may be tremendously changed.

### Importance of Depreciation and Appreciation

Depreciation and appreciation have assumed an especial importance in the past few years, partly because of the necessities imposed by tax requirements and partly because of the extreme fluctuation in dollar values. In the past a concern may have taken depreciation in proportion to the year's earnings, that is, large amounts in some years and little or nothing in others. It may also have gone on the basis of writing off its properties as completely and rapidly as possible, with the result that the book values of the property accounts become meaningless, while at the same time profits were understated for one period and overstated for subsequent periods. If property values are later re-established on the basis of normal and regular depreciation, a fairly true picture may be obtained, and the increase in net worth thus secured is in the nature of earned surplus.

But if property accounts are appreciated solely on the basis of the change in dollar value—for purposes of financing—a very different result will be attained. The increased property accounts call for increased depreciation. Thus net profits will be decreased and the former ratios of earnings to capital will be greatly changed.

### Basic Elements of Analysis

Stress has been placed upon the accurate determination of earnings by years. It is important to know whether operations are normally consistent, or whether it is characteristic of the business or of the whole industry to have irregular earnings, as good years followed by bad years. It is important to know the exact effect of outside conditions on the business. Thus in some cases of excellent management there were *bona fide* normal earnings in the years 1921 and 1922 when the majority of business showed either losses or abnormally low earnings. In some cases such drastic inventory losses were taken in 1920 or 1921 that the business showed fictitious earnings in 1921 or 1922, giving a false impression of early recovery from the industrial depression. Similar effects may have been obtained by inequitable deferment of selling, general or advertising expenses in years of actually small profits.

The inequalities between years are of lesser importance where the results from operations averaged over a 5 or a 10-year period, but the analysis by averages cannot be substituted for the analysis by years, since a different purpose is served. The analysis by averages should give an index as to the normal expectancy of return on sales and on capital as well as to show the normal proportions of different classes of cost and expense. This analysis has been difficult during the past decade in many businesses.

For example, some industries had a very substantial prosperity in the years 1915 and 1916 because of war work for the Allies. Some businesses were depressed in 1917 and 1918, while many others reached a high level of activity in war work for the United States Government. The years 1919 and 1920 were generally prosperous for all businesses and all industries, while 1921 and 1922, to a lesser extent, were almost disastrous. These profound industrial inequalities, operating largely independent of the individual business, must be considered in arriving at the average of normal expectancy.

In some businesses it is possible to average the years 1922 to 1925, inclusive. In most businesses 1919, 1920 and 1921 must be totally disregarded. In many businesses no use can be made of the war years 1917 and 1918. Sometimes averages may be struck for several different periods and comparisons made of these periodic averages. Thus if the years 1913 to 1917, inclusive, are used, there may result a fair pre-war average which may not be greatly at variance with that obtained by averaging the years 1918 to 1922, inclusive, or the years 1923 to 1925, inclusive. In each business individual judgment is necessary in establishing the bases which can safely be used for this class of analysis.

### Sources of Profit

Closely related to the study of averages is the study of the sources of profits. It may be that favorable

showings are made almost entirely by reason of low costs and a high gross, while much money is practically thrown away by reason of loosely controlled and extravagant sales policies; or a "sellers market" and correspondingly high prices may permit profits despite lax and inefficient operating. Conditions of easy profit were more common a decade or two ago than they are now, when improved processing, improved transportation, bulk production and national advertising and distribution are continually increasing the pressure of competition.

There are profits which are outside of the results from normal operations and which must be defined and segregated from operating profits. This includes capital gain, such as results from the advantageous sale of land, buildings or equipment. It also includes financial gain, interest on securities held which are not essential to the conduct of the business. Thus one business habitually held a half million dollars' worth of federal securities, which was really surplus capital and which gave a return not to exceed 4 per cent. In the analysis of return on capital it was necessary to deduct the half-million dollars from capital employed and the $20,000 from income before the normal results from operations could be judged. Such an existent condition is, of course, illuminative in judging the characteristics of the management.

In all of this analysis the predominant idea is to secure from the past some basis for judging the probabilities of the future. To the findings on the particular business must be added the findings on general status and trend of the industry, and often the general economic status and trends of the nation and the world.

### The Profit and Loss Statement

In a summary statement of operations there will appear 12 principal items in a natural sequence, as follows:

1. Sales
2. Returns, allowances and discounts
3. Net sales
4. Cost of sales
5. Gross profit
6. Selling expense
7. Administrative expense
8. Net operating profit
9. Miscellaneous income
10. Interest paid
11. Federal taxes
12. Surplus net profits

It will be noted that gross sales is clearly distinguished from net sales and that some prominence is given to deductions from sales. This is essential for purposes of investigation. Often allowances and discounts are merged with selling expenses, serve to distort the amount and percentage of such expense and giving a false analysis of this phase of operations.

Back of the single items of gross sales and net sales it is always necessary to set up supporting analytical schedules in greater or less detail, dependent upon the importance of the sales situation in the whole analysis.

Almost invariably there are several sales products and it is important to show the volume of sales of each product by years. This permits a study of the trend and importance of each item of product, some of which may be on the increase and others on the decrease, to the point where it may be advantageous to withdraw from that market. This is particularly true where there are various models of a general type of product and the older contribute such small volume as not to warrant the investment in machinery, patterns, tools, inventory, etc., necessary to their continuance. Sales by the different products in units is usually a valuable subsidiary schedule, since apparent sales trends in values are often the distorted result of price fluctuations.

A schedule showing geographical distribution of sales, either in units, values, or both, is often highly significant as showing undue concentration in some territories, lack of development in others, too wide a spread of sales effort, sales in sections where freight charges are prohibitive, or sales possibilities in virgin territory through use of water transportation. Sometimes this analysis will show a concentration of sales at a point so far distant from the factory as to indicate savings through branch production or through a jobbing connection.

Schedules showing the percentage of total sales by years to a few principal customers may reveal the dangerous situation of dependence on a single industry, or upon the favor of one, two or three customers. Usually security results from diversification, and this in sales analysis means diversification of territory, customers, and industries.

There must be applied to the results of sales analysis much the same modifying factors which were considered in connection with earnings. The effect of local and general economic conditions, intensity of competition and the protection afforded by patent or manufacturing monopolies, stage of development of the particular art or industry, all must be given full weight in judging the effectiveness of management control over sales in the light of results attained.

### Consideration of Gross Profits and Costs

If the cost of sales can be broken down exactly as sales have been analyzed, that is, by products, models, etc., it becomes possible to show gross profits according to sales classification. This becomes valuable material for analysis, since it often reveals many profit inequalities. For example, there are in many businesses certain products which are sold at low margin of profit for the purposes of securing volume and of introducing other and more profitable lines. It may well be that without careful control or without constant analysis these "leader" lines are sold at a loss or at no profit. Similarly, it sometimes occurs that lines supposedly highly profitable and, therefore, strongly pushed by the sales management are yielding a low return.

A valuable form of analysis is a tabulation showing the percentage of sales which each line bears to sales

as a whole, and which sets forth in a parallel column the percentage of gross profit contributed by each line. It has been found that one product which comprised 50 per cent of the total sales contributed 80 per cent of the gross profit, while another product contributed 20 per cent of the sales and showed a 10 per cent gross loss. Instances have been noted where a company would have had higher gross and net profits if it discarded nine of its ten sales products.

Such inequalities indicate either a poor managerial control or else a pressure of outside conditions which is so severe that the issue might better be evaded by a complete revision of sales policies.

### Mental Standards for Certain Businesses

Long experience in the study of gross profits results in the setting of certain mental standards for certain classes of business. Thus certain types of industry are known to require approximately a 60 per cent gross profit ratio in order to produce a satisfactory percentage of net profit, while other industries require only a 25 per cent gross in order to show a proper net. It becomes possible by the law of averages to say whether a low net result is a primary product of ineffective manufacturing or of extravagant and selling policies.

Naturally, the accuracy of gross profit determinations in yearly operating statements depends to a great extent upon the accuracy and consistency of inventory taking and pricing, while the accuracy of monthly gross profit figures depends upon the reliability of costs and perpetual inventories. This means that the investigator has a duty in checking the probable accuracy of the important elements of costs and cost of sales as a preliminary to the use of such figures for analytical purposes. Even if yearly cost of sales figures are correct, the current costs may be incorrect, the surest index to this condition being found in the amount of the discrepancies between physical and book inventories.

Since gross profit is a resultant of selling price and manufacturing cost, prices must also be considered in this analysis. It may be that sales volumes, and hence costs, are directly influenced by fluctuations in price. Often an attempt to establish prices on the basis of costs alone is a disastrous move, since too high a cost in the first place may lead to a prohibitive price, which reduces sales volume, raises costs, and thus leads theoretically to a still higher price. In some cases prices are worked out on practically a budget basis by anticipating a certain sales volume, calculating costs on the proposed volume and then adding a proper gross profit. In other cases it will be found that there is no flexibility to the price range, prices being controlled by the effect of dominant competition. In this latter situation the only chance of increasing gross profit lies in more economical manufacturing.

It is sometimes considered that gross profit is the responsibility of the manufacturing organization and that net profit is the responsibility of the administrative and selling personnel. It is evident, however, that this is not entirely true, since selling prices are usually in large part set by the sales organization. But once the gross profit has been made, the question of whether or not there is a satisfactory net is governed largely by the amount of and control over general and selling expenses.

The simplest index to these classes of expense lies in the ratio they bear to total sales. If there were no selling expense except a direct salesman's commission the percentage would be absolutely uniform, unless the rate of commission were revived. This is seldom capable of attainment. Due to fixed charges for sales offices and equipment, advertising, clerical salaries, shipping expense, etc., a condition usually exists that causes decreased sales volume to result in an increased ratio of sales expense. An increase in sales may or may not result in any important decrease in this ratio, since increased sales may mean increased commissions, warrant increased salaries, call for increased clerical assistance, and be secured through increased advertising or promotional sales effort.

The ratio of general expense to sales will fluctuate almost directly with increase or decrease in sales, since it is usually fairly fixed and stable in amount. The important points of analysis, therefore, consist in a study of the items making up these expenses, to determine whether they are justified at all, whether they are too large, whether they betray an attitude of indifference or extravagance upon the part of the management, or whether some increase caused by additional records and systems might not be of far reaching benefit by giving better executive control.

### Factors Based on Sales Dollar

It has been found possible in some businesses to study the history and actualities of selling and general expense so closely that they are currently controlled on the basis of so many cents per sales dollar, both as a whole and as individual items. Thus salary costs may be dangerous if exceeding 11 cents on the sales dollar, rental of sales offices must not exceed 2 cents per sales dollar, etc.

In addition to this type of analysis, a number of important indications as to the policies and attitudes of the management may be gathered from a study of certain items by years. Thus an increase in bad debt losses leads to inquiry as to the cause, whether due to laxness in the credit department or to a deliberate intention to increase sales volume by more widespread sales. A change in advertising appropriations will always lead back to a distinct change in policy whether of changed advertising media or basic sales policies. Sometimes a decrease in advertising is attended by reduced prices, by greater quantity discounts, by the introduction of consignment sales, etc., and there the relationship is fairly obvious. Final operating figures must be studied as the resultant of management policies rather than as an end in themselves.

# Reducing Costs 22% by Motion Study

## At Same Time Wages Increased 50 to 60% and Labor Turnover Practically Disappeared

By JOSEPH A. PIACITELLI

[illegible]

THE thoughtful consideration of motions has been traced back to the pictures sculptured by the Babylonians in the dawn of written history.[1] Nothing was done toward making a systematic analysis or applying measurement to them until the late Frank B. Gilbreth founded Motion Study. Since then, its progress has been marked by a series of applications resulting in production economies.

Two of the major factors of Motion Study are the elimination of unnecessary motions in a cycle of motion and the utilization and alteration of the necessary ones to produce a given unit of work in the minimum time and with the least expenditure of energy, with due consideration to the surrounding conditions, tools and equipment.

The true value of a method of analysis, or in fact any form of activity, can only be measured by the results obtained by the execution of such activity. In view of the situation outlined above the writer will confine himself to some of the practical applications which have been made in the production and shipping of roofing materials at one of the Maurer, N. J., plants of the Barber Asphalt Company, and to some of the means provided to maintain the results accomplished.

In one of our Madison, Ill., plants a machine was developed for the stapling and folding of Latite shingles. This machine requires the services of four men while the one which was being used by us at Maurer at that time, and on the same work, employed a crew of seven. It was not until this new type of machine had been in successful operation for one and one-half years at the other plant that the first one was installed at Maurer. The men operating the old machines were given places on the new. With very few exceptions the same methods were adopted. In this way the skill and experience were transferred from one type of machine to the other. In spite of the fact that these men were already trained they were unable to make a fair day's output and one of our first problems at Maurer was to find a more economical method of performing this work.

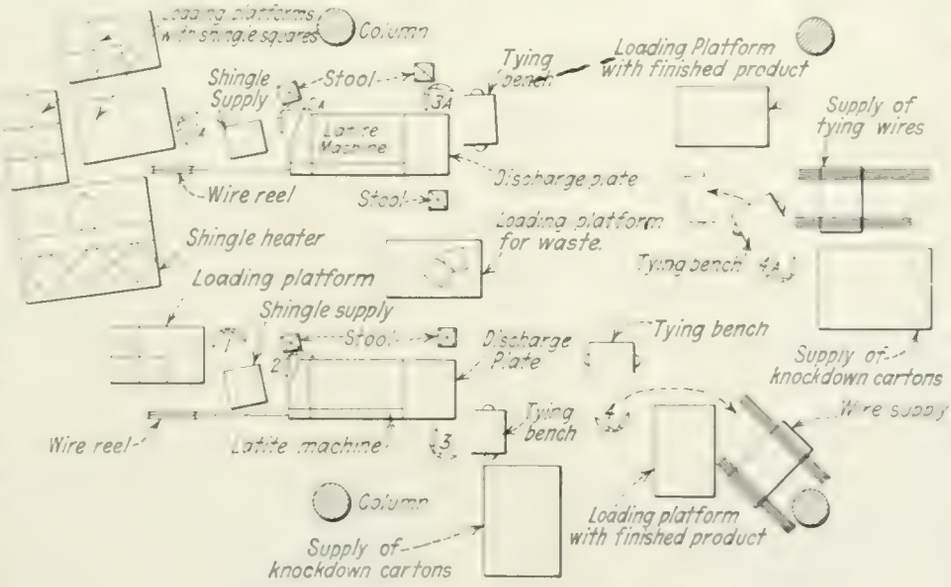



FIG. 1 LAYOUT OF LATITE MACHINES

Studies were begun by considering the complete process of folding the 16"x16" Latite shingles and by analyzing each suboperation with the aim of eliminating unnecessary motions and unnecessary fatigue.

For the purpose of recording the existing methods, a sketch (Fig. 1) was made showing the layout of the machines and equipment so that it furnished enough data to permit a description and study of the methods of handling the shingles. The shingle squares were transported on metal platforms and put in the heater by man 1 who arranged them in stacks of approximately 3 feet high and so that only one corner of them would be subjected to the heat. When heated to the desired temperature these shingles were transported by him in a stack about one foot high to the supply table, from which they were lifted one at a time by man 2 who fed them into the machine for the folding operation.

The shingles were discharged by the machine on to the discharge plate; stacked into a carton positioned in a tying bench as shown by man in position

[1] "Science in Management for the One Best Way to Do Work," by F. B. and L. M. Gilbreth, Ph.D. III Me. Conferenze Internationale de Psychotechnic Applicate a l'Organizzazione Professionale —Milan, Italy.

No. 3 in Fig. 1. The package tied by him as shown in position No. 4 and the finished product was stacked on to a loading platform near the wire supply. Each of the two packers performed the stacking and tying operations necessary for the completion of each package and consequently alternated in these functions.

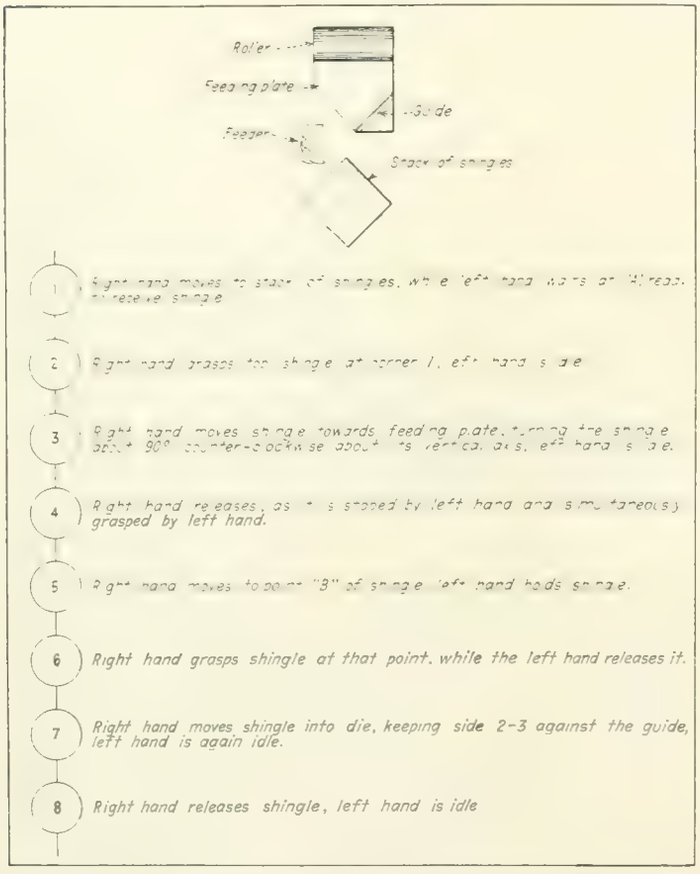

Roller
Feeding plate
Guide
Feeder
Stack of shingles
1 Right hand moves to stack of shingles, while left hand turns at "A" releases shingle
2 Right hand grasps top shingle at corner 1, left hand is idle
3 Right hand moves shingle towards feeding plate, turning the shingle about 90° counter-clockwise about its vertical axis, left hand is idle.
4 Right hand releases, as it is stopped by left hand and simultaneously grasped by left hand.
5 Right hand moves to point "3" of shingle left hand holds shingle.
6 Right hand grasps shingle at that point, while the left hand releases it.
7 Right hand moves shingle into die, keeping side 2-3 against the guide, left hand is again idle.
8 Right hand releases shingle, left hand is idle

FIG. 2 PROCESS CHART OF FEEDING 12 IN. AND 16 IN. LATITE SHINGLES BY OLD METHOD

It was found that each man had been allowed to develop his own method and in the various sub-operations, such as feeding the shingles into the machine and packing them after they had been discharged from it, the touch of individuality was quite prominent. Each of the men performing the same operation felt that his method was the best. The correct one was that which could only be determined by a careful analysis of the number of motions involved, their character and their sequence. The output of the machine was controlled by the feeding operation and this marked the starting point of our studies.

The complete cycle of motions was made by the feeder in approximately one and one-half seconds and its simplicity made accurate observation possible without the use of a motion picture camera. The method was recorded in the Process Chart shown in Fig. 2 for the purpose of making a thorough investigation of the possibilities of eliminating unnecessary motions, and to do the work in the least fatiguing way. The cycle consisted of ten therbligs or elements of motion. Of these ten 8 were performed by the right hand,

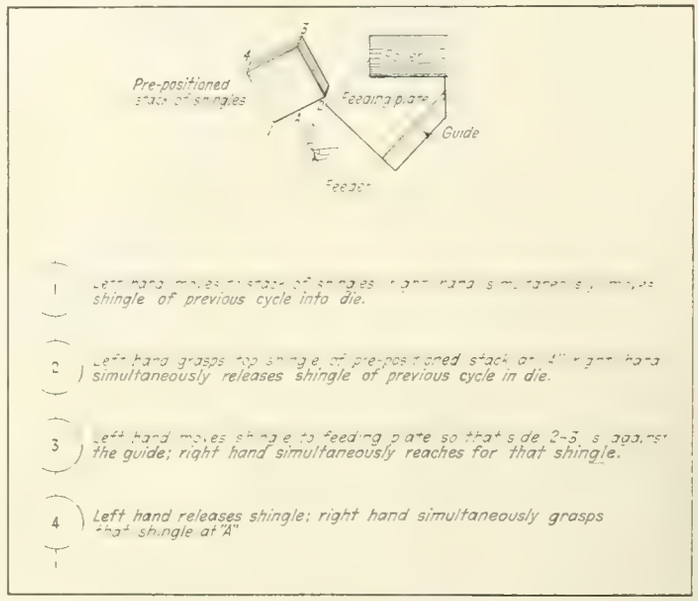

Pre-positioned stack of shingles
Feeding plate
Guide
Feeder
1 Left hand moves to stack of shingles; right hand simultaneously moves shingle of previous cycle into die.
2 Left hand grasps top shingle of pre-positioned stack at "A"; right hand simultaneously releases shingle of previous cycle in die.
3 Left hand moves shingle to feeding plate so that side 2-3 is against the guide; right hand simultaneously reaches for that shingle.
4 Left hand releases shingle; right hand simultaneously grasps that shingle at "A"

FIG. 3 PROCESS CHART OF FEEDING 12 IN. AND 16 IN. LATITE SHINGLES BY NEW METHOD

hence, during eight-tenths of the cycle the left hand remained idle. This produced an unbalanced condition and caused the time for the complete cycle to be wholly dependent on the work of the right hand.

Further analysis showed that the right hand grasped the shingle once more than necessary because it did not properly do so at the beginning of the cycle, requiring the second grasp to feed the shingle into the machine. The left hand merely held the shingle while the other was in the act of changing grasp. The unnecessary "Grasp" and "Release" were eliminated and the work was so arranged that the two hands performed an equal number of elements of motion simultaneously, thus placing an equal burden of four therbligs to each hand. Process charts in Figs. 2 and 3 offer a means of comparison of the old and new

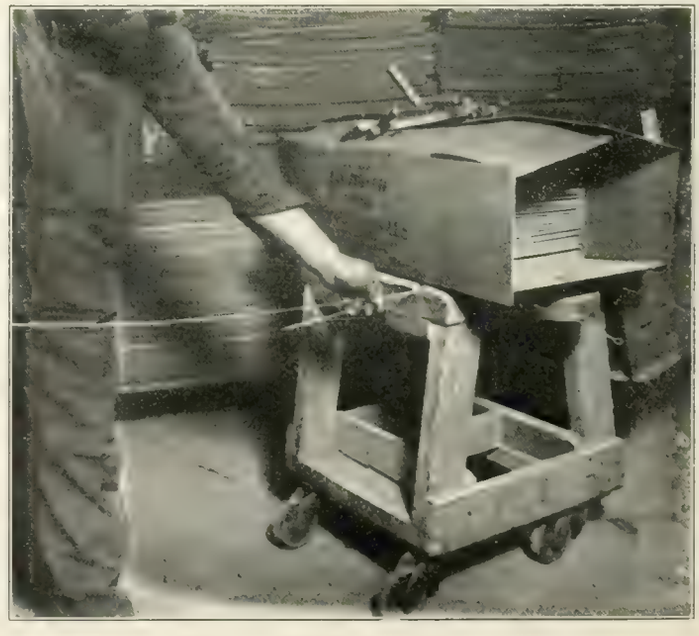


FIG. 4 WIRES POSITIONED AT WRONG TIME

methods. This study resulted in the reduction of time to one-half of the original which increased the ability of the feeder 100 per cent.

As a result of this analysis we were able to feed the machine at a much faster rate than the men at the discharge end could pack them. Our efforts were then exerted towards devising a better method of performing the packing operation. This process by the old method consisted of a series of sub-operations

FIG. 5 SAVING TIME AND EFFORT BY DEVICES DESIGNED AFTER ANALYSES OF METHODS

Shows pre-positioned wires and knockdown cartons.

which, when studied, resulted in a radical change in the equipment. The packing was accomplished, by the old method, first, by inserting a knock-down carton in a fixture mounted on a tying bench equipped with casters; second, by stacking a definite number of shingles into the positioned carton and, third, by tying the package with four wires.

The analyses of these sub-operations showed that the stacking could have been made simpler and easier to learn by reducing the number of positions in which the shingles were stacked. This variation is necessary to a certain degree in order that the fold on the corner of the shingle, producing a double thickness at that point, will not appear in the same relative position, thus providing for an even distribution of the added thickness. However, the questions in our minds were, How many of these variations can we eliminate? What arrangement of the shingles would make possible a method involving fewer and simpler motions and yet maintain the quality of the package?

Our answer to these questions is a method which requires the shingles to be stacked in two positions instead of four as in the old arrangement. This change effected the production in two ways: first, it reduced the stacking cycle from four to two sets of motions, thus enabling the new employee to learn the method involved in his work more quickly; and, second, the motions necessary to do that work were simplified and made less fatiguing by changing the relative heights of the discharge plate of the machine and the stacking table so that the shingles are now practically dropped in place, while by the old method they were raised into the fixture.

The study of the next operation, that of tying the cartons of shingles, pointed to many possibilities of savings. In accordance with the old method, after stacking the shingles, the packer would push the fixture which was mounted on casters, to a point about 15 feet away, where the wires with which to tie the carton were located. To tie the carton it was necessary for this man to position the four wires under the carton of shingles, two in one direction and the others at right angles to them. See Fig. 4.

To make sure that every phase of the tying operation was analyzed properly a process chart was made covering the cycle of motion in such detail that there was no doubt as to the actual moves the man made while performing his work. But what did the chart do for us? It merely provided a means of making a careful study of the method with absolute disregard of the time element, enabling us to point out possibilities of savings.

Why should the packer be required to move the tying bench containing the stack of shingles a distance of 10 to 15 feet, when it may be possible to

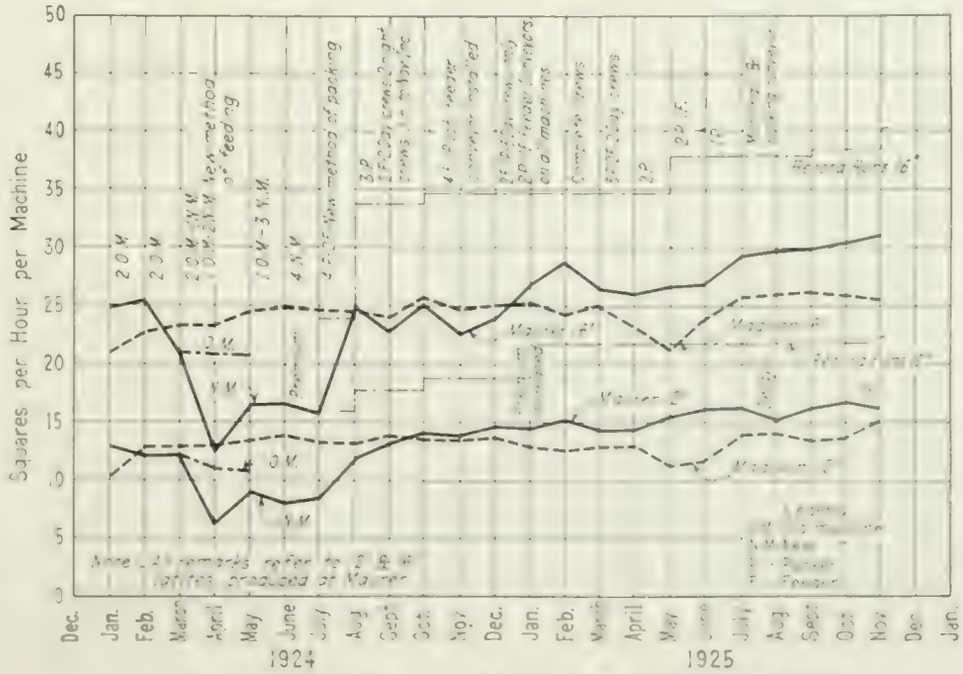



FIG. 6 COMPARISON OF [illegible]

avoid it? Why not preposition the wires instead of positioning them after the shingles had been stacked? Why expect the man to pick up the knock-down carton from the floor, raising it about three feet to assemble it into the fixture for the next operation, when it may be stored in a more convenient place? These were only a few of the most prominent symptoms indicating unnecessary exertion of effort and after the consideration of them, together with other items indicating possible improvements, a stacking and tying table was made composed of two sections of roller conveyors joined to form a unit on which the stacking fixtures are mounted. See Fig. 5.

This unit is divided into two sections in order that each of the two packers may have a separate set of equipment and a definite work place. The use of this new piece of equipment permits the men to do the stacking and tying work in the same place, thus avoiding the transportation necessary by the old method, and wires are now pre-positioned in approximately one-tenth of the time formerly required. A table was also made to hold the supply of knock-down cartons within arm length of the worker and at a level above the height of the new stacking device in order that they may be inserted into the fixture with the minimum of effort.

The foregoing discussion has special reference to the folding and packing of 16″ Latite shingles, but it applies also to the folding and packing processes for the 12″ Latite shingles, because many of the sub-operations are common to both, except that the stacking cycle for the 12″ shingles consists of four sets of motions and the box of shingles owing to its smaller size requires only two wires. The same organization is employed in folding these shingles but being smaller and having a lower covering factor the amount of work required to fold and pack one half of a square of these shingles is approximately equal to that required for one square of 16″ Latite shingles. ("Square" in the roofing industry, means enough shingles to cover 100 square feet of roof). With the above in consideration a box of one-half square of the 12″ consisting of 86 shingles and a package of one square of the 16″ requiring 82 shingles were placed on the same basis.

FIG. 7 PROVIDING ELASTICITY BETWEEN FUNCTIONS BY CONVEYOR

Note pre-positioning of shingles for easy grasp.

The chart in Fig. 6 shows the average monthly rates of production of 12″ and 16″ Latite shingles at our plant compared to those at Madison. Analysis of the graph representing the 16″ shingle will readily point out the effect of the changes in method on the rate of production.

The first of the new machines was installed in March 1924. The point for that month represents the average rate of output for both the old and the new type although the latter was operated only a few days during that month. From that time on, however, the rates were plotted separately in order to show just how much each type of machine contributed to the average rate of production for each month.

FIG. 8 LIFTING 125 LB. PACKAGE. ONE OF THE CAUSES OF LOW PRODUCTION

In April 1924 one of the new type of machines was operated and its rate of output during that month is shown to be very low, approximately 12.5. Our work began at this time and during the latter part of the month we established the new method of feeding, the result of which is shown by the rise in the graph to a higher level, and which was maintained until August 1924 when the new method of packing was made effective. This shows that the solution of the packing phase of the process contributed more than any other toward the increased rate of production, and is shown also by the graph made for the 12″ shingles which itself is, with few exceptions, quite similar to that for the 16″ shingles.

The new methods were planned two months after the studies were begun and we were then able to predetermine the rate of production which would be reached when they were completely installed and automaticity of methods developed. On the strength of this data a premium on this work was made effective in July 1924 when the rate of production was about one-half of that expected. In January 1925 this premium was increased to balance an increase in the going wages of the vicinity.

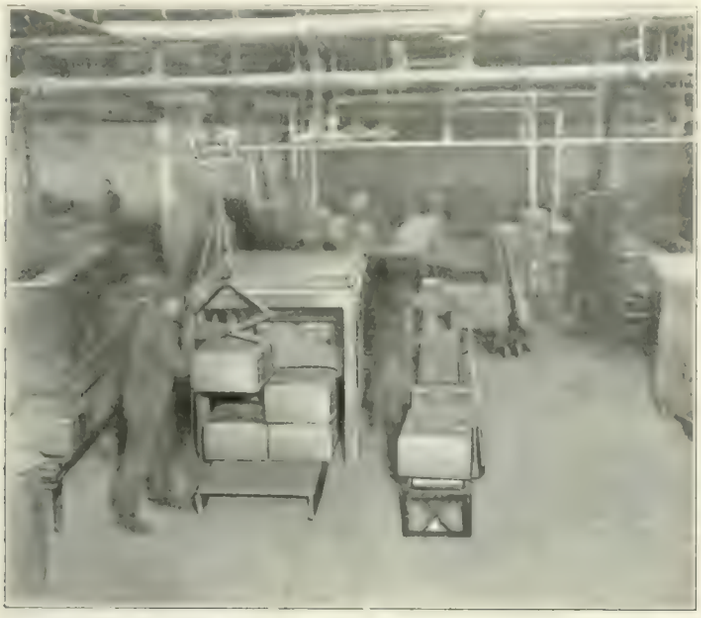


FIG. 9 FATIGUE REDUCED

With the new methods of feeding and packing installed, our attention was turned to the handling operations performed on the shingles before they reached the feeder and after they were packed.

The reader will note that a feeder conveyor (gravity carrier) was installed on one of the machines in November 1924. See Fig. 7. This was done with the aim of minimizing the transportation of shingles by the man supplying the feeder who approximately every minute carried a stack of heated shingle squares, weighing from 50 to 75 pounds, an average distance of eight feet. This conveyor not only reduced the transportation but also provided elasticity between the two functions. Two months later this type of conveyor was installed on all machines and these have reduced the transportation to about two steps in each case. The good effect of fatigue reduction in this suboperation is evident in the rise in the rate of output to a new level (January 1925) which was maintained until July 1925 when the next step was taken toward fatigue reduction.

Perhaps one of the most interesting points in this plane of production rate is that of February 1925 which when compared with the rates of output for the months of January, March, April, May and June of the same year indicates the importance of reducing the labor turnover on this work. The labor turnover for each month is indicated by the abbreviations 3P; 2F, etc. (3 packers; 2 feeders, etc.) and the absence of turnover during the month of February explains, to our satisfaction, the comparatively high mark reached during that month. It will be noted also that during this period the number of packers replaced is more than two times the number of feeders and the answer to this may be given in the word *fatigue*. The packer in performing his work was required to stack each bundle of shingles weighing approximately 125 pounds on to a loading platform, and it was often necessary for him to lift it as high as three feet in doing it. See Fig. 8. At a moderate rate of speed this was done every four minutes and we cannot expect a man to maintain a high rate of production when he is burdened with heavy work.

To remedy this condition we installed a roller conveyor enabling the packer to get rid of the package by merely pushing it off the stacking and tying fixture on to the conveyor. By this means the package moves down to the other end of the conveyor from which it is lifted, and is stacked on a loading platform by the trucker who is equipped with a hand hoist suspended from a monorail trolley. See Fig. 9.

The installation of these fatigue reducing devices produced the expected results, namely, the reduction of labor turnover to one exit during the past seven months, and the maintenance of a high rate of production as shown by the last five points charted. Although these devices were also used in the production of 12″ Latites, they had no marked effect on the rate of output as may be noted by an inspection of the curve representing it. This may be explained by the fact that the box of 12″ shingles weighs about

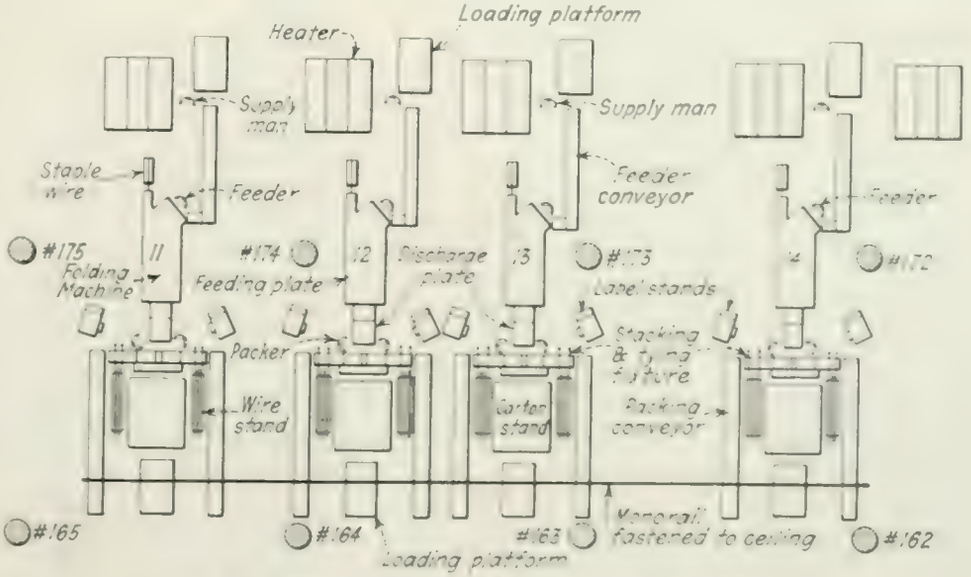



FIG. 10 LAYOUT OF LATITE MACHINES AND EQUIPMENT

75 pounds, and that the fatigue resulting from this work was not enough to seriously effect the production while in the handling of the 16″ package weighing 125 pounds, the fatigue was a very important item.

The maximum output made for a run of eight hours, or more, is represented by the lines "Record Runs" which also show the effects of the introduction of better methods.

Although approximately 34 per cent above the average monthly output, these graphs have risen with the latter, as may be expected, and show clearly the probabilities of further increases in the monthly average production.

The Madison plant represented by the dotted lined graphs has made very little improvement, if any, and it is apparent that their methods will not permit them to do better.

As shown in Fig. 10, the equipment and machines were changed and rearranged to permit the men to perform their work without any unnecessary exertion of effort and this study may be summed up by the results obtained and which are as follows.

The rates of production of the 12″ and 16″ shingles have been increased to 12 and 20 per cent respectively, above the rates of the Madison plant where the principles of Motion Study have not been applied, nor have the methods of doing this work been standardized.

The unit cost of folding 12″ Latites has been reduced 23 per cent while that of the 16″ has been reduced 22 per cent.

The earnings of the men have increased 60 per cent when producing the 12″ Latites and 51 per cent when producing the 16″ shingles.

Motion studies were made of other operations such as cutting and packing 10″, 12½″ and Extra Heavy Strip Shingles; cutting 12″ and 16″ Latite squares; cutting and packing regular and Extra Heavy Individual Shingles and in each case we did not fail to affect economies in production primarily by reducing the waste of labor effort.

# A Double-Purpose Platform for Handling Material

CONDITIONS of operating economy frequently require installation of different types of mechanical handling equipment to move the same material in different parts of a manufacturing plant. An example is the use of a fleet of lift trucks in one department and an overhead control system in another.

An example of the use of these two systems is from the plant of the A. P. W. Paper Company. Here arrangements have been made to transfer material from lift trucks to the trolley of the overhead system without rehandling. The device adopted is very simple, consists merely of an eyebolt at each corner of the platform carrying the stacked material and chain slings to send the platforms from the lifting hooks to the trolley. The device and method are shown at the right in the accompanying illustration, Fig. 1.

As a sheet of pulp comes from the roll of the machine in the pulp mill it is caught up by a man, folded into a bundle and deposited upon the skid platform standing in a convenient location beside the pulp machine. When the platform is loaded the lift truck picks it up and moves it to a storeroom of the adjacent paper making plant.

This storeroom is the starting point of an overhead trolley line which conveys the pulp to the first process in paper making. Here each platform is swung by two chain slings previously mentioned. When lifted by the two hooks, the double hoist riding on the rolley rail, the platform is lifted up to a four-point support. It then can be moved easily and quickly wherever desired.

FIG. 1 LOADED TRUCKS READY TO BE TRANSFERRED TO OVERHEAD TROLLEY

This conveying equipment also handles pulp which arrives from Nova Scotia either in freight cars or by ship at the company's dock. Whether received by rail or by water, the first unloading of this pulp places it upon truck platforms piled as shown in the illustration. It then is moved to the storeroom by lift trucks and enters the maunfacturing processes in the same way as the pulp which is manufactured at the plant.

# Solving Difficult Handling Problems

## Driver-Harris Company Overcomes Obstacles Typical in Average Plants

By JAMES B. TRAVERS

*Assistant Superintendent, Driver-Harris Company*

I HAVE often envied the apparent lack of trucking problems in new and carefully laid out manufacturing plants such as those which are common in the automobile industry. With the sequence of operations and departments laid out in the ideal fashion, conveyors can be used in many places and such trucking as must be done can be scheduled to the best possible advantage.

Unfortunately, the majority of factories do not come under this classification. Some of the buildings are old and some new. The old ones were usually put up long before modern material moving equipment was devised, when heavy materials had to be transported by brute strength perhaps with the aid of two-wheeled stevedore trucks. In such a plant it is a real problem to work out a way in which materials can be moved at the least cost. A lot of makeshifts must be employed and the equipment is apt to be in the nature of the best possible compromise. The more diverse the product and the processes through which it must pass the more difficult the problem becomes.

Take our own plant for instance. We make a great many varieties of wire, for one thing. We make it of copper, brass and various other alloys for electrical resistance and for the heating elements of electrical appliances. Some of the wire is insulated, some bare.

Another part of our business has nothing to do with wire. Having specialized on the making of alloys for various purposes we make castings of various shapes and sizes of non-corrosive metals such as nickel-chrome steel. Some of these castings are large pots for use in annealing ovens, others are so small that they can be put in a vest pocket.

I mention this to show that the loads we have to move vary from single pieces weighing a couple of tons to small pieces of which a thousand or so can be put in a tote box. Also there is a wire which may be so fine that you can lift several coils with one hand, or it may be a large coil of heavy wire that is all one man can lift.

Our plant has grown with the years until it now consists of several buildings, some old and not so well adapted to modern transportation as they might be—others well adapted and wholly modern. These last were erected mostly during the war.

Sometimes it is necessary to haul materials three city blocks from plant to plant, through the streets, as the foundry and hot mill are that far apart.

For moving a large part of our product we use wooden boxes as they can be employed with satisfaction for a diversity of purposes. It was natural therefore that we should experiment with skids and hand lift trucks. We ran into some snags, however, caused by the physical conditions in the plant.

In some places the machines were so closely spaced that only very narrow hand lift trucks could be used.

FIG. 1—CLARK TRUCTRACTOR AND TRAILER HANDLES 400 TONS OF METAL PER DAY

In other parts of the plant, especially in the new buildings, plenty of space was available.

This condition made it necessary to have several widths of lift trucks to fit special conditions. That is always a disadvantage, for in material handling equipment standardization on as few types and sizes as possible is always an influence working for low costs and efficiency.

When material was ready to be moved from one of the departments in which adequate trucking space was lacking due to the proximity of machines, we would often find that the narrow trucks were all at the other end of the plant. Also some of our materials could not be handled at all on the narrow trucks. When a wide one was needed in a place where space permitted its use, we too often had to instigate a search to find the truck which was needed. This condition was not due to poor management—it was inherent in the conditions which existed.

So we were forced to discontinue the use of lift trucks. It is not the fault of the trucks but of our layout of machines. For many purposes we would prefer to use lift trucks, for now the work has to be lifted by hand rather than by power onto the platform of either a hand truck or a power truck.

We use two types of power trucks, electric and gasoline. See Fig. 1. Equipped as they are with platforms they can be used either to carry loads or as tractors to haul trailers. Because we seldom have very large loads to haul on a single trip they are usually used directly to carry the load. Seldom are they called upon to haul more than one trailer.

Both types, the electrical and gasoline, serve our needs admirably. Equipped with three wheels they have short turning radiuses and can be used in almost any corner of the plant. They are equally effective for handling ingots, heavy castings, coils of wire or boxes filled with small parts or scrap.

All trucking aisles in the plant or in the yards are paved. In the yards and the foundry the paving is of concrete, to facilitate the operation of the power trucks.

In the foundry, the molds are handled with jib cranes and chain hoists. See Fig. 2. In a few places we have installed monorail overhead trolleys for short hauls.

A crane truck (see Fig. 3) is used in and around the hot mill to handle billets, wire and coils or strips of flat metal. This truck saved the very heavy investment which would have been involved in an overhead traveling crane and a runway extending out into the yard so that material could be moved directly from storage to the furnaces. Moreover, it saved taking down small overhead trolleys carrying billets from the furnaces to the mills. The crane truck performs all the necessary work in and outside of this building at a very nominal cost.

We have not found is necessary to work out a comprehensive plan of scheduling the movement of our trucks as I know has been done in a few plants. We know that it is not practicable in a plant such as ours and I doubt whether it is feasible in the majority of manufacturing establishments.

The foremen of the various departments are expected to foresee as far ahead as possible their needs for trucks and to notify the truckers when they will be needed. All lots of materials to be moved carry with them in plain sight a move ticket which gives full instructions to the trucker as to its destination. While this method may seem to lack the polish of more elaborate systems, it works with complete satisfaction and at insignificant cost. Practically never is a lot sidetracked or production delayed through failure of material to be where it should be when it is needed.

In fact, in our plant accurate scheduling is not only not needed—it would be downright impossible, for many of the movements can not be forecast. It is necessary to anneal some of our products between operations. This accounts for a great deal of our trucking, for the wire must be moved from the drawing machines to the annealing furnaces. It is not always possible to tell how many times a product will have to be annealed.

We expect to be able to reduce the cost of moving

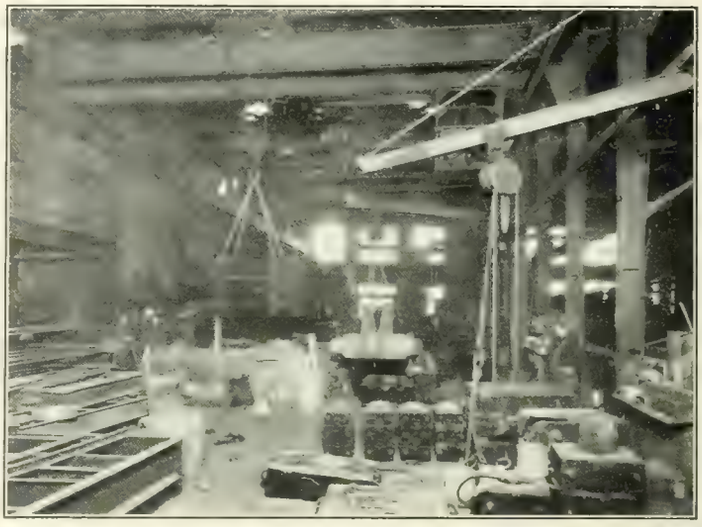


FIG. 2 IN THE FOUNDRY JIB CRANES AND ALFRED BOX 10-TON TRAVELING CRANES HANDLE MOLDS AND CASTINGS

between the annealing ovens and the other operations considerably by installing a power conveyor. The ovens are on the first floor of one building while the drawing operations are on an upper floor of another building about 150 feet away.

At present the wire must be transported between these departments on hand trucks due to the fact that the elevator is too small to accommodate our power

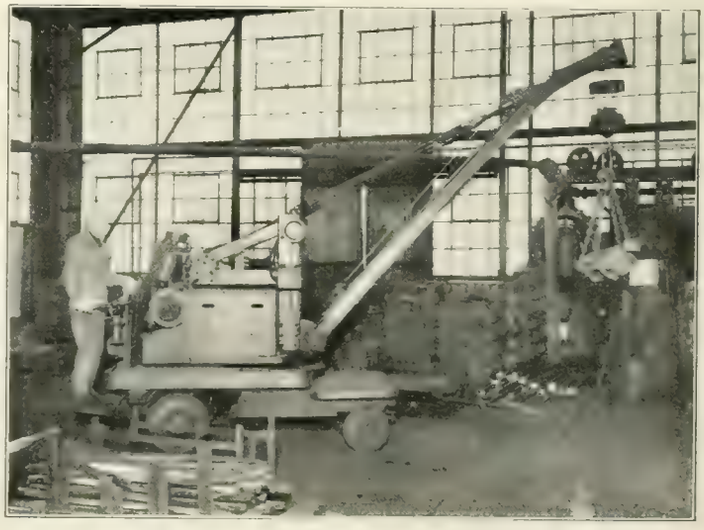


FIG. 3 BAKER CRANE TRUCK WHICH DOES ALL THE HANDLING INSIDE AND OUTSIDE OF HOT MILL

trucks. This keeps several men busy all of the time.

The conveyor will run at an incline from the floor of the oven room, through the roof, across the yard and through the side of the other building. It will carry coils flat, and will also be equipped with horns

on which to hang the lighter coils of wire. It will carry wire in both directions, and although it will cost less than $4000 it will save at least $20 a day in direct labor of truckers and greatly speed up production.

In wire drawing, diamond dies, sometimes costing several hundred dollars each, are of course employed. They are kept in a safe when not in use. Formerly we would deliver them to the drawing department, which is in another building, by messenger. Occasionally a messenger would succumb to temptation. Moreover, manual handling represented waste labor. To prevent such losses we devised what I believe is a somewhat novel adaptation of the conveyor idea. A wire trolley is run from the stockroom where the dies are stored to the wire drawing department. At all points it is too high in the air to be reached from the

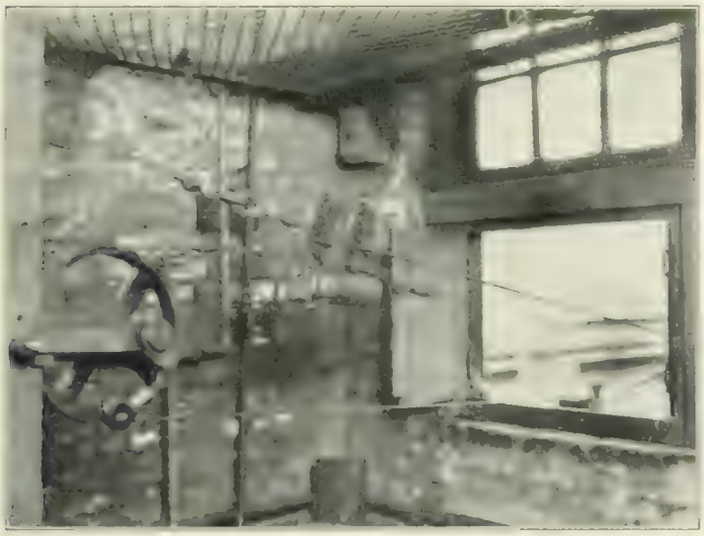


FIG. 4 TROLLEY SYSTEM FOR DIAMOND DIES

ground. On this wire a metal cylinder is run which is under lock and key. See Fig. 4. The conveyor was inexpensive to build and costs nothing to operate. Since it was installed we have suffered no losses of the expensive dies.

As many concerns use dies and other highly valuable materials our device may offer an idea which will help others to solve what was to us an important and somewhat delicate problem.

Although the layout of our plant and the peculiar conditions under which our work must be done, prevent us from making wide use of conveyors, we realize that conveyors are ideal equipment in many places.

In one building we have to transport bundles of long metal rods from one floor to the floor below. This necessitated trucking to the elevator and on the floor below from the elevator to the machines. A little study showed us that one of the departments could be moved so that the two would be in a vertical line. Then by the simple expedient of cutting a hole approximately one by two feet in dimension in the concrete floor, and making a wooden chute to fit it, the bundles of rods can be slid directly to where they are to be used. This saves us considerable in trucking expense at a negligible cost for the equipment.

It was not possible to build a shipping platform outside, as this part of the plant was right up to the building line on the street. Hence an inside platform was constructed (see Fig. 5) with storage space beneath and the windows were converted into doors. A chain lift with lugs, or dogs, was installed on the incline to help carry the shipping trucks to the platform level.

I do not want to go on record as advocating makeshifts in any phase of manufacturing. It is far better to take all sides of the production problem into account when designing a plant. But unfortunately not every concern is in a position to junk the buildings which it has and build anew an ideally adapted plant. Most concerns are in the position where they have to do the best they can with what they have. Buildings have to be erected to suit the size and shape of the existing available land, and there are other common handicaps under which production must struggle.

In such a case careful thought and study will usually show ways in which costs of handling can be reduced materially. It will generally be found that no one type of equipment will serve all purposes because of the varying conditions. In such a plant hand trucks of one type or another will be best suited in one place; electric trucks may exactly fill the bill for another purpose, and gasoline power be the best for another. Here a power conveyor will fit in to best advantage; there a gravity conveyor can be utilized. Sometimes a little work by the millwright will save large sums of money.

We feel that our handling costs are just about as low as they can be gotten under the conditions. Were we to scrap our entire plant and rebuild with an eye to the best possible layout, it might be possible to reduce our material handling costs somewhat. But the carrying charges on the new construction would be so heavy as to far more than offset the saving obtainable from a rearrangement made solely to suit material handling requirements throughout the plant.

FIG. 5 INSIDE SHIPPING PLATFORM AND INCLINED CHAIN LIFT

# The Break-Even-Point Chart a Management Tool

By F. J. REUTER

*Director of Testing Laboratories, Lazote, Inc.*

THE break-even-point chart is to a manager what a compass is to a mariner. It shows just which way he is sailing, toward profit or loss—toward his destination or toward a wreck.

The accompanying illustration shows the break-even-point chart used by a successful concern engaged in the manufacture of yeast. The job of the manager is to pilot his business so that the vertical line AB is moving toward the right edge of the chart, since the vertical AC means profit if on the right side of point P, and loss if on the left side.

This chart shows that the break-even-point is at 45 per cent of the plant capacity, the point where the total sales and total costs are equal, and the corresponding lines cross each other. The vertical AC, actual condition for the 1925 month in question, shows a profit of $18,000.

Furthermore, this chart gives the measure of accomplishment by the percentage of expenditure, profit or loss, and the ratios of operating expenses. Charts of this kind made with budget figures, and subsequently filled in with actual sales and operating figures, give an interesting picture of managerial efforts. They can be drawn on tracing cloth for about $10 and blue prints made for $0.20 a piece.

During 1913 I had the task of revising the design of almost all the compound punch press tools in a large manufacturing concern. The failures of the springs used in these tools were alarming because of the constant interruption entailed. This revision of equipment would have been a long and tedious task without the above-mentioned chart. With it the entire job was done in a surprisingly short time.

During the World War, at the Creusot Works, the revision and new design of war armaments created a difficult situation due to the shortage of qualified engineers and the pressure for immediate delivery of equipment. This led the able chief engineer, a former student of Professor D'Ocagne, the father of the alignment chart theory, to the use of alignment charts as tools in all the departments where much figuring was done. Charts were made on a suitable grade of paper and drawn to convenient dimensions. The result on the work was amazing in the saving of time and money.

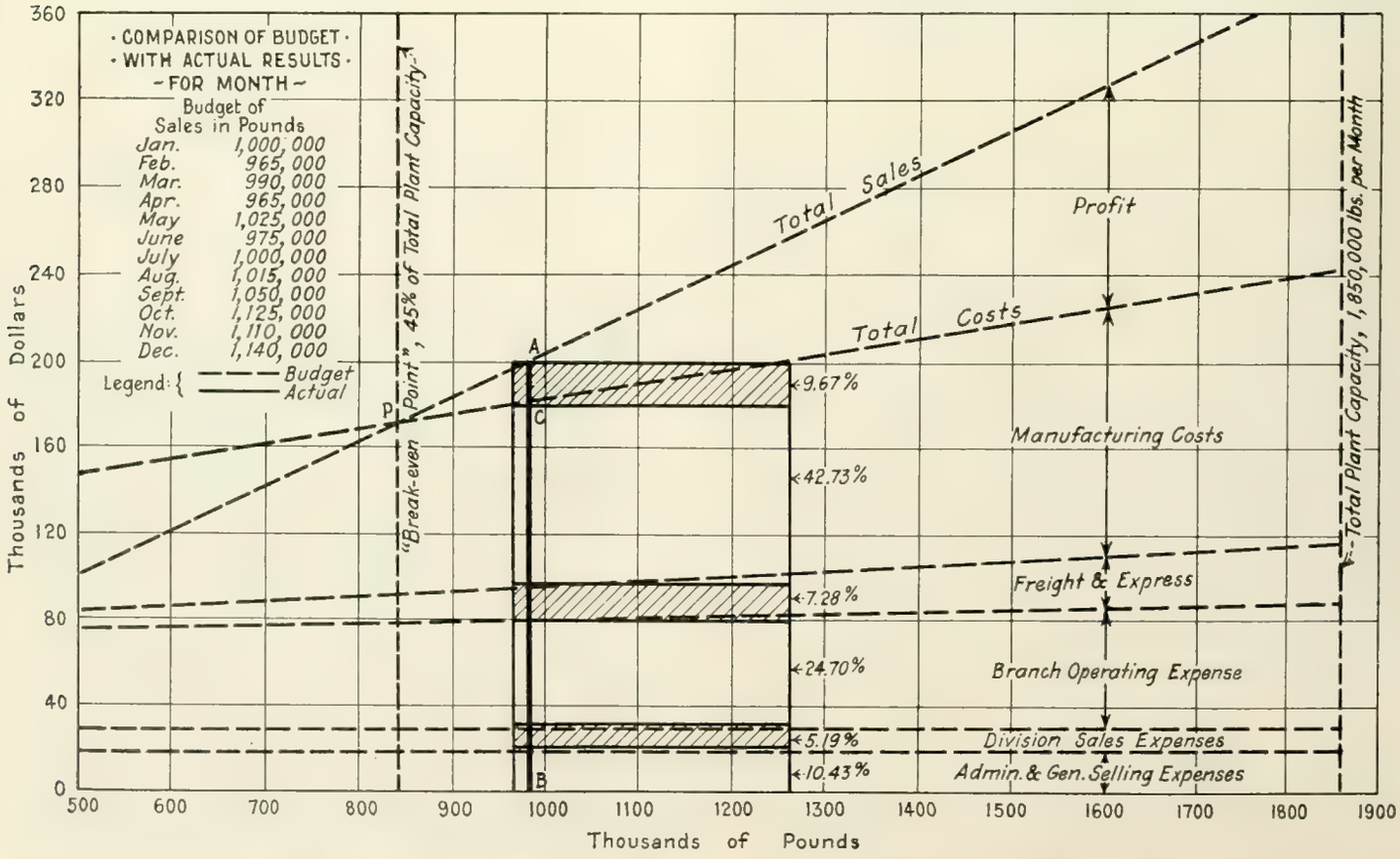



FIG. 1 TYPICAL ALIGNMENT CHART USED FOR BUDGETING IN A YEAST FACTORY

# General Motors "Purchasing Power" Index

## A Guide to Marketing Effort in Different Territories*

By H. G. WEAVER

*Assistant to Director, Sales Section, General Motors Corporation*

MANY data exist which reflect directly or indirectly the relative economic importance of the various counties in the United States, and extensive use has been made of them in connection with market analysis and advertising. The market for the average product depends upon purchasing power and this in turn depends primarily upon the income enjoyed by a given territory.

The county data generally available are:

| | |
|---|---|
| Value of manufactured products | Magazine circulation |
| Value added by manufacture | Number of retail outlets |
| Value of mineral products | Automobile registrations |
| Value of fishery products | Number of telephones |
| Value of farm crops | Bank deposits |
| Population data | Number of banks |
| Income tax data | Industrial wage earners |

Incomes by counties are not available, but for certain past years reliable estimates of incomes by states have been developed by the National Bureau of Economic Research. On the basis of tax returns, crop reports, debits to individual accounts and other available data it is possible to develop similar estimates for later years. By this method the income of each state in the union was estimated and these estimates, coupled with the estimates of the National Bureau of Economic Research, provided us with data whereby the average income of each state might be estimated for the past five years.

It was evident that if some kind of formula could be developed which would enable us approximately to calculate this known quantity of income for each state, and if in the development of this formula we would use only such data as were also available by counties, we would then have a formula which, in all probability, would be approximately true for the calculation of county income.

By reducing the state data to a percentage of the United States basis it was possible to appraise each factor as regards its correlation with the per cent of effective income in each state. Over 1000 tests were then conducted involving various combinations of the percentage data to determine just which elements provided the best indices to effective income. The following were chosen as the most pertinent or "appropriate" material to use for this particular purpose:

A=Per Cent of Value of Products including:
- Added by manufacture (U. S. Census, 1919)
- Farm crops (U. S. Census, 1920)
- Live stock products (Estimated by Crowell)
- Mineral products (U. S. Geological Survey, 1922-1923)
- Fishery products (U. S. Bureau of Fisheries, 1920-1923)

B=Per Cent of Retail Outlets (R. L. Polk Census, 1922)
C=Per Cent of Total Population (U. S. Census, 1920)
D=Per Cent of Income Tax Returns (Bureau of Internal Revenue, 1922)

It was found that the proper combination of these percentages lay somewhere between a simple average and a weighting of the income tax data twice, three, four and five times. The formula reads:

$$\frac{A + B + C + M \cdot D}{N}$$

Where M is a multiple (1, 2, 3, etc., of the factor D) and N is an arbitrary divisor.

Thus, the state of Alabama represents:

A=1.22% U. S. total value of products
B=1.26% U. S. retail outlets
C=2.22% U. S. total population
D=0.64% U. S. income tax returns

The approximate ratio to be arrived at is:

K=1.09% U. S. total effective income

The four pertinent factors were worked into formulas as follows:

FORMULA 1. $\frac{1.22 + 1.26 + 2.22 + 0.64}{4} = 1.33\%$

FORMULA 2 $\frac{1.22 + 1.26 + 2.22 + 2 \times 0.64}{5} = 1.20\%$

FORMULA 3 $\frac{1.22 + 1.26 + 2.22 + 3 \times 0.64}{6} = 1.10\%$

FORMULA 4. $\frac{1.22 + 1.26 + 2.22 + 4 \times 0.64}{7} = 1.04\%$

FORMULA 5. $\frac{1.22 + 1.26 + 2.22 + 5 \times 0.64}{8} = 0.99\%$

By applying these five formulas to all the states it was found that the following number of calcula-

* (This index has been extensively used by the General Motors Corporation for the past year and a half. Mr. Weaver has just been awarded the Edward Bok prize of $2000 for this development, the most outstanding research in the selling and advertising field in 1925.—The Editors)

tions fell within 10 per cent of the known quantity K, the estimated state income: Formula (1) 26; (2) 35; (3) 46; (4) 44; (5) 41.

While the foregoing results are predicated upon a "cut and try" process, there is ample scientific justification for the use of these combined factors as an index to income. However, it was evident that no one formula would answer for all states but that a final choice would have to be made on the basis of individual state groups. Hence a "similarity table" of states was worked up in seven columns headed:

1. Average effective per capita income
2. Ratio $\frac{\text{Effective income}}{\text{Number of tax returns}}$
3. Per cent population in cities over 25,000 (1920 census)
4. Retail outlets per 100 sq. mi. farm area (Polk and U. S. Census)
5. Per cent native white population (1920 census)
6. Ratio $\frac{\text{Value added by manufacture}}{\text{Value crops and live stock products}}$ (Crowell Publishing Co.)
7. Value of mineral and fishery products as a percent of total value of products (Crowell Publishing Co.)

An exhaustive analysis of this table led to the conclusion that states could not be successfully grouped solely on geographical location. The only practical grouping for measuring purchasing power seemed to be by characteristic factors as developed in the similarity table.

The basic classifications determined upon through the use of this table were as follows:

1. Southern Group.—Characterized by low per capita income and extensive agricultural operations. (South Carolina, Georgia, Alabama, Mississippi, etc.)
2. Sparsely Settled Western States.—Characterized by high incomes, range cattle and mining operations. Arizona, Nevada, Montana, etc.)
3. Urban Group.—Thickly settled industrial states having a high percentage of population in large cities. (New York, Rhode Island, Massachusetts, Illinois, Michigan, etc.)
4. Miscellaneous and Hybrid Groups.—Some states do not fall under the distinct classification and must therefore be tested with groups especially designed for the purpose. (West Virginia, for example, appears to be a cross between Pennsylvania and Oklahoma. Main, New Hampshire and Vermont have the characteristics of Massachusetts, on the one hand, and Montana on the other.)

We are now in a position to apply our formulas to selected groups corresponding more closely to the conditions represented by the relations between the different counties within an individual state.

On the basis of the various groupings and combinations of groupings, 18 groups were tested in addition to the preliminary tests on the United States as a whole. These tests not only covered states that were economically similar but also a number of groups that dovetail into one another with the idea of getting as many different kinds of combinations as appear likely to occur as between the counties in any single state.

Through such group testing, the formula best suited to each state was determined, as shown in Table 1. Incidentally, the formula finally chosen for a given state was not necessarily the same as the formula which showed the best agreement for that particular state according to the calculations above described.

In the case of such states as Alabama, Mississippi, Georgia, etc., it was established that Formula 2 would give the most accurate results. Hence, the conclusion is drawn that Formula 2 will give the best results for the individual counties composing Alabama.

By applying the percentages developed in this way to the effective income for the state as a whole, we arrive at an estimate of the total effective income received by each county and then by dividing this effective income by the population of the county we can determine the effective per capita income for each county. Our final product therefore provides us with income data for each county expressed in three ways:

1. The effective income of each county as a per cent of the state total.
2. The amount of effective income received by each county expressed in dollars.
3. The effective per capita income of each county expressed in dollars.

The following example shows the derivation of this data for Autauga County, Alabama:

Autauga County as a per cent of the Alabama state total has
0.91% of total value of products in the state
0.59% of retail outlets in the state
0.80% of total population in the state
0.23% of number of income tax returns in the state

$$\text{Income ratio} = \frac{0.91 + 0.59 + 0.80 + 2 \times 0.23}{5} = 0.552\%$$

In other words, Autauga County receives 0.552 per cent of Alabama's income. The average effective income of Alabama for the past five years is estimated at $706,600,000. Therefore, 0.552 per cent of $706,600,000 gives an estimate of $3,900,452 representing the annual effective income received by Autuaga County. The population of Autauga County is 18,908. $3,900,432 divided by 18,908 gives us an average annual effective per capita income of $206.

The adaptation of such basic data to the practical problems of marketing must obviously vary according to the individual nature of each product.

TABLE 1. FORMULAS APPLIED TO INDIVIDUAL STATES

| State | Formula | State | Formula | State | Formula | State | Formula |
|---|---|---|---|---|---|---|---|
| Alabama | 2 | Iowa | 3 | Nevada | 2 | South Dak. | 2 |
| Arizona | 2 | Kansas | 3 | New Hamp. | 3 | Tennessee | 3 |
| Arkansas | 2 | Kentucky | 3 | New Jersey | 4 | Texas | 2 |
| California | 4 | Louisiana | 2 | New Mexico | 2 | Utah | 3 |
| Colorado | 3 | Maine | 3 | New York | 4 | Vermont | 3 |
| Connecticut | 4 | Maryland | 3 | North Car. | 2 | Virginia | 2 |
| Delaware | 3 | Mass. | 4 | North Dak. | 2 | Washington | 3 |
| Dist. of Col. | | Michigan | 3 | Ohio | 4 | West Va. | 3 |
| Florida | 2 | Minnesota | 3 | Oklahoma | 3 | Wisconsin | 3 |
| Georgia | 2 | Mississippi | 2 | Oregon | 3 | Wyoming | 2 |
| Idaho | 2 | Missouri | 3 | Penna. | 4 | | |
| Illinois | 3 | Montana | 2 | Rhode Island | 4 | | |
| Indiana | 3 | Nebraska | 3 | South Car. | 2 | | |

# The Guide to Latest Information

## One Hundred Best Selections for April*

By THE EDITORS

THIS [illegible] for the use of plant managers and manufacturing executives. It is worth more than a mere glance. Each item should be carefully scrutinized, both to see if the article or book annotated is not one which should be secured and read, and also to keep in monthly touch with the important results accomplished and discoveries made in the wide field of activities for which plant executives are directly responsible. The material noted is the latest available.

Twice as many items are collected monthly as are published. Hence those printed have gone through two consecutive tests of their value—first, as to their actual utility to plant managers, and, second, as to their superiority over other material of a similar nature. Both published and unpublished items are permanently preserved in a card index file extending back over a period of almost three years, and now numbering many thousands of entries.

## Industrial Buildings and Plant Maintenance

### Buildings and Equipment

**Air Treatment in Heating and Ventilation.**

The [illegible] of heating and humidifying or de-humidifying air. *Engi-*[illegible] 1926 pp. 58-60. Illus. Index no. 658.25

**Engineering and Management Phases of Oxwelded Construction.**

A [illegible] addresses which have appeared in engineering publications. The factors covered are: Methods of selecting workmen; inspection of material; design and layout; organization and operators technique; tests of completed work. Linde Air Products Co. 64 pp. Illus. Index no. 69

**Factors in Chemical Plant Location.**

[illegible] prise may hinge on consideration of raw material and power supply. Labor supply and transportation facilities. Muscle Shoals used as an example. *Chemical and Metallurgical Engineering*, Feb. 1926, pp. 83-5. Index no. 658.21.

**How Many Stories Should a Factory Have?**

Hunley Abbott. *Factory*, Feb. 1926, pp. 276-7, 378, 380, 382, 384, 386. Illus. Index no. 658.23.

**Insurance Against Wind Storms.**

Dwight Ingram. Its importance; improved forms of policies; typical middle western rates; deciding how much to carry; the hail storm factor; practical points on construction to avoid wind damage. *Pit and Quarry*, Feb. 15, 1926, pp. 75-8. Index no. 368

**Modern Design Features New Planer Plant.**

Forrest E. Cardullo. The G. A. Gray Co. have recently put into operation the world's largest plant devoted exclusively to planer manufacture. Article describes the new building and its construction, lighting, heating, material handling and service facilities. Table contains detailed data. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 261-5. Illus. Index no. 658.2

**Modern Soda Pulp Mill**

E. P. Wood. Description of the design, construction and equipment of the new soda pulp mills of the Tonawanda Paper Company, Inc. *Paper Trade Journal*, Feb. 25, 1926, pp. 147-9. Illus. Index no. 658.2.

**Water—Where the Ounces of Prevention Save Pounds of Trouble.**

K. D. Hamilton. Description of the principles and methods of securing adequate water supply for industrial purposes. The author is mechanical engineer, Geo. E. Keith Company. *Factory*, Feb. 1926, pp. 279-81, 320, 322, 324. Illus. Index no. 658.238

## Organization, Management and Administration

**Forecasting the Manufacturing Program**

Leonard Tyler. American Management Association, New York. Pamphlet, 16 pp. Index no. 658

**Forecasting the Underlying Cycles.**

Joseph H. Brown. A new [illegible] problem of developing an external volume [illegible] estimating probable trend of incoming orders. Mr. Barber uses four indices from the Federal Reserve Bulletin [illegible] for "gross profit margins." This paper is one of the real recent additions to our knowledge [illegible] Management Engineering Apr. 1926 pp. 253-6. Illus. Index no. 658

**Forecasting Stabilizes Operations.**

Albert Bradley. Forecasting procedure of the General Motors Corporation, whereby uneven production and excessive inventories are avoided. The four major factors given [illegible] conditions of general business, competition [illegible] Mar. 31, 1926 pp. 691-6. Illus. no. 658

**Getting the Most Out of Your Machine Tool Dollar.**

M. H. Wentzel. [illegible] The earnings of a locomotive in service are [illegible] expedite repairs even though the actual saving [illegible] investment in a new machine tool. *American Machinist*, Feb. 18, 1926, pp. 261-2. Index no. 658.27.

**Hudson Assets Multiply 430 Times in Seventeen Years.**

A. Motelle. *Automotive Industries*, Feb. 11, 1926 pp. 210-13. Illus. Index no. 658

**The Industrial Executive.**

B. A. Franklin. Ronald Press Co., New York. 146 pp. $1.25. Index no. 658. Proportionately more and more individuals are flocking into industrial pursuits on the one hand, and the ownership of industry and dependence upon its operation are becoming more widespread on the other. These circumstances, together with the increasing pressure of competition and the increasing difficulty of earning a reasonable profit, are throwing a heavy burden of responsibility upon the industrial executive. Mr Franklin, appreciating the importance of these circumstances, has written a thoughtful, constructive presentation of the work of the [illegible]

responsibilities which must be discharged are emphasized, helpful methods and suggestions for their accomplishment are presented in considerable detail. The book is thoroughly practical and should be in the hands of every active operating official, manager and executive. Because of the practical idealism which like a glistening thread runs through all the chapters, the book brings real inspiration to thought, study, experimentation and action.

**Made-to-Order Manufacturing Orders.**

H. M. Gano. The author points out the advantages of selective control of manufacturing orders. These are: Fewer rush orders; earlier delivery in case of need; meeting a large percentage of delivery promises; low production costs; increased production; improved production control; less confusion and conflict. *Society of Industrial Engineers Bulletin,* Feb. 1926, pp. 3-6. Index no. 658.

**New Fields for Modern Management.**

Wallace Clark. Uses of the Gantt chart for administrative control. *American Machinist,* Feb. 18, 1926, pp. 285-7. Illus. Index no. 658.

**Organizing for Production in the Acheson Graphite Company.**

A. M. Williamson. American Management Association, New York. Pamphlet. 12 pp. Index no. 658.56.

**Waste in the Paper Industry.**

G. D. Bearce. Report of the Committee on Waste of the Technical Association of Pulp and Paper Industry. This study was undertaken in 1922 and a series of reports have since been prepared and presented. This deals with white water losses, mill operating results, stock recovery, waste sulphite liquor and stream pollution. *Paper Trade Journal,* Feb. 25, 1925, pp. 143-6. Index no. 658.567.

**We Are Cutting Overhead Every Day.**

J. A. Goodman. Methods used by the Real Silk Hosiery Mills to produce savings equivalent to $3,000,000 sales increase. *System,* Mar. 1926, pp. 347-50, 449, 450, 451-4. Illus. Index no. 658.5.

**We Make Purchasing a Real Job of Management.**

C. W. Nash. President of the Nash Motors Co. declares that he devotes just as much time to purchasing as he does to supervising production. *Factory,* Feb. 1926, pp. 259-61, 288, 290, 292. Illus. Index no. 658.72.

# Power Generation and Transmission

## Fuel

**By-Product Processing of Coal.**

H. W. Brooks. Methods of by-product processing and converting coal into more valuable forms—carbonization of coal, complete gasification, high- and low-temperature carbonization, typical low-temperature retorts. *Mechanical Engineering,* Mar. 1926, pp. 233-9. Illus. Index no. 662.6.

## Power Generation

**Adapting the Steam Turbine to the Industrial Power and Heating Load.**

C. S. Coggeshall. The author discusses the diversified demands of the industrial plant and describes a line of turbines which, like sectional filing cabinets, can be set up to meet almost any requirements. *Power,* Mar. 2, 1926, pp. 329-32. Illus. Index no. 658.261.

**Engineers Should Control Power Production.**

Lynn A. Armantrout. Starting with the assertion that industrial plants are prone to use more power than steam in manufacturing processes than actually required, the author shows how to establish record system, aimed to increase and improve power economy. *Power Plant Engineering,* Feb. 15, 1926, pp. 254-7. Illus. Index no. 658.26.

**Factors Governing the Purchase or Generation of Power**

W. A. Shoudy. Sets forth the factors to be considered and followed in answering such questions as "Can we afford to purchase power?" or "Can we afford to generate power in our own plant?" Among the factors considered are use, interest, depreciation, taxes, insurance, rental, operating charges, operating labor, repairs, maintenance, fuel, by-product uses. The author states that the average performance of the better central stations is production of a kilowatt-hour for from 16,000 to 20,000 B. t. u. If all the process steam were used in an industrial plant for power generation the excess power could be generated for about 6000 B. t. u. per kilowatt-hour, or at less cost than it can be generated in the modern central station. *Power,* Mar. 9, 1926, pp. 385-6. Index no. 658.26.

**Industrial Power Plant of the Whitin Machine Works.**

L. R. Ball. Description of how a large textile machine concern rebuilt its power plant, changed its frequency of current from 40 to 60 cycles, replaced reciprocating engines with a bleeder turbine. The power plant supplies 40 acres of floor space with heat, light, power and process steam. The principal equipment is listed in detail. *Power,* Feb. 16, 1926, pp. 242-6. Illus. Index no. 658.26.

**Industrial Use of the Diesel Engine.**

Max Rotter. Consideration of Diesel installations showing what is involved in increased efficiency, costs of fuel and lubrication, maintenance, and fixed charges. *Power Plant Engineering,* Feb. 15, 1925, pp. 263-4. Index no. 658.26.

**Layout and Equipment of Industrial Power Plants.**

Paul L. Battey. Analysis of commercial and technical problems of the industrial power plant. Numerous interesting examples are given of modern design, and suggestions for operating engineers in order to secure maximum efficiency. *National Engineer,* Mar. 1926, pp. 89-95. Index no. 658.26.

**Machine Control and Regulation of Combustion.**

J. F. Shadgen. The development of mechanical control systems whereby the regulation of power plant apparatus is accurate and continuous. Descriptions of numerous such control devices. *Power Plant Engineering,* Mar. 1, 1926, pp. 311-12. Illus. Index no. 658.26.

**Possibilities of Obtaining Industrial Power from Public Service Corporations.**

L. R. Nash. Comparison of economies of the central station and the individual industrial power plant to determine the relative cost of power. *Stone and Webster Journal,* Feb. 1926, pp. 149-58. Illus. Index no. 658.26.

**Power Generated from Process Steam Yields Large Profit.**

William R. Johnson. By using a bleeder turbine, wool-scouring plant operated by Eavenson and Levering Co. gains nearly 100 per cent on investment yearly, or $36,554. *Chemical and Metallurgical Engineering,* Feb. 1926, pp. 95-6. Illus. Index no. 658.26.

**Utilization of Abandoned Power Plants.**

H. A. Woodworth. Suggestion that industrial power plants put out of use by purchase of central station current can be used for central steam heating, manufacturing of gas and ice, and as standby equipment. *Steam Power,* Feb. 1926, pp. 6, 12. Index no. 658.26.

## Power Transmission

**Motor-Driven Pump Compresses Steam for Ovens.**

Guy B. Randall. A new development in the method of heating furnaces for drying, japanning, enameling, vulcanizing and the like in connection with manufacturing processes. Briefly the proposal is to take steam at atmospheric pressure or low pressure for factory use, and by means of a motor-driven compressor increase the pressure and thereby the temperature to whatever is required for the process. The practical advantage is the ability to change the pressure, increasing it during the time when the oven is being brought up to temperature, and then reducing the pressure during the actual processing period. It will be realized that this proposal is a reversal of the steam engine cycle. *Power,* Mar. 9, 1926, pp. 375-6. Index no. 658.26.

**Power Requirements of Paper Machines.**

S. A. Staege. *Paper Trade Journal,* Feb. 25, 1926, pp. 215, 217, 219. Index no. 658.26.

**Tension Ratio and Transmissive Power of Belts.**

C. A. Norman. *Mechanical Engineering,* Mar. 1926, pp. 240-5. Illus. Index no. 658.262.

**What May Be Expected of Good Leather Belting.**

Louis W. Arny. Leather belt that ran 48 years in the power plant of the Bernon Mills at an average cost of only $0.042 per horsepower. *Belting,* Feb. 1926, pp. 14-15. Illus. Index no. 658.262.

# Marketing and Distribution

## Advertising

**Post Graduate Copy Course.**

Advertising Club of New York. Seven pamphlets. $5. Index no. 659.1. A set of seven lectures issued separately in pamphlet form as follows: 1. Letters, Correspondence, Direct Mail, by John H. Wright. 35 pages. 2. Local Newspaper Copy, by Amos Parrish. 22 pp. 3. Trade and Technical Paper Copy, by Harry Tipper. 24 pp. 4. Mail Order Copy, by Walter M. Ostrander. 26 pp. 5. Copy for National Newspaper Campaigns, by E. M. Swasey. 15 pp. 6. Copy for National Magazine Campaigns, by Earnest Elmo Calkins. 22 pp. 7. Co-ordination of Copy in General Campaigns, by George W. Hopkins. 21 pp. The lectures were given on different evenings during 1924 and 1925 before classes conducted by the Advertising Club of New York, and were followed by discussions which are included in the pamphlets. The material represents the most advanced and successful practice and the lecturers are all leaders in their particular fields.

## Selling

**Breaking Through Competition.**

Ray Giles. D. Appleton and Co., New York. 179 pp. $2. Index no. 658.8. Competition, while it is the stimulant of business, may degenerate into petty selling stratagems, price shavings, quality manipulation, and other undesirable practices. The present book aims to concentrate on the larger perspective and explain a few basic factors of more fruitful measures. To this end the author discusses topics such as: Ways and means of competition; adding new markets to old; "How many customers make a market?"; specialties; the color factor; buying habits; increasing the number of dealers; keeping sales costs down; product and package; co-operation of wholesaler, retailer and salesman.

**Credit Granting Abroad.**

Lewis S. Thomas. Methods used by the Monongah Glass Co. to assemble facts and develop a credit report on foreign customers. *Credit Monthly*, Mar. 1926, pp. 10, 31, 32, 36. Index no. 658.882.

**General Motors Purchasing Power Index.**

H. G. Weaver. Data and formulas developed to show purchasing power by counties in all states as a basis for correct sales quotas. Used successfully for the past 1½ years by the General Motors Corporation. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 291-2. Index no. 311.

**Pricing for Profit vs. Pricing for Volume.**

W. L. Churchill. Manufacturers have generally believed that increase in volume of business always brought an increase in profits. Mr. Churchill shows that this is a fallacy, ascribes many industrial ills to the practice of pricing goods too low in order to secure a volume of orders. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 267-70. Index no. 658.8.

**Putting Across the Big Order.**

Walter F. Wyman. Analysis of reasons why some salesmen can sell carload orders while others sell only cases. *Printers' Ink Monthly*, Mar. 1926, pp. 25-6, 124, 126, 129, 130. Index no. 658.85.

**Selling the Big Automotive Manufacturer.**

W. B. Calkins. Methods of the purchasing department of the Willys-Overland Co. The salesman is given every reasonable opportunity to come in contact with production men and fully present the strong points in regard to product. *Class*, Mar. 1926, pp. 15-18. Index no. 658.72.

## Packing, Shipping, Transportation

**Cans (Inside Containers) for Liquids, Semi-Liquids and Pastes.**

Recommended construction for closure, side seam and bottom seam of cans for lard, peanut butter, or similar commodities, where the gross weight of each package is approximately 50 lb. or less. Information is also given in regard to material for such cans and tests to reveal leaking seams. Freight Container Bureau, American Railway Association. Bulletin No. 1, 4 pp. Jan. 2, 1926. Index no. 658.788444.

**Crates for Cast-Iron Household Cook Stoves and Ranges.**

Design and specification for crating for cast iron cook stoves and ranges. The design is simple, effective, and can be made with a minimum of materials and labor. Freight Container Bureau, American Railway Association, New York. Circular No. 20. Jan. 2, 1926. 19 pp. Illus. Index no. 658.788444.

**How Standardization Solves Our Export Packing Problems.**

Raymond W. Chalmers. Description of the methods used by the Chevrolet Motor Co. in packing for export. *Factory*, Feb. 1926, pp. 272-5. Illus. Index no. 658.7884.

**Money Saved Through Proper Crating Methods.**

G. E. Heck. Typical economies secured in redesigned crates. *Barrel and Box*, Feb. 1926, pp. 11-12. Illus. Index no. 658.788444.

# Production Control and Material Handling

## Production Control

**Comparing Equipment and Methods for Quantity Production.**

E. P. Blanchard. Methods used in studying the economy of different production methods so that the most efficient equipment for producing given quantities may be selected. *Machinery*, Mar. 1926, pp. 535-8. Illus: Index no. 658.5424.

**Controlling Production Mechanically.**

William F. Bailey. Description of the material dispatching system of the Hoover Company. Among these are a reduction of 75 per cent of the average capital invested in material-in-process; reduction of 45 per cent in labor force required for inspection and stores. *Factory*, Feb. 1926, pp. 262-5, 340, 342, 344, 346, 348, 350. Illus. Index no. 658.514.

**Maintaining Hourly Control of Production.**

George G. Brooke. Edward G. Budd Mfg. Co. have developed a method of production control which is immediate, functions continually and exactly, and has considerably reduced operating expenses, notably in eliminating losses through inventories. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 271-5. Illus. Index no. 658.5.

**More Castings in Smaller Space.**

Rogers A. Fiske. Mechanical equipment in the foundry of the Nash Motors Co. By the installation of this mechanical molding and conveying equipment the productivity of each man has been increased from 30 to 50 per cent; the investment in flask equipment has been reduced about $50,000. *Iron Age*, Mar. 11, 1926, pp. 677-80. Illus. Index no. 658.542.

**Reducing Costs 22 Per Cent by Motion Study.**

Jos. A. Piacitelli. Not much information is available as to the results of motion study. This article therefore is exceptional, giving as it does the practical methods of applied motion study to packing operations and the savings secured. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 281-6. Illus. Index no. 658.542.

**Repairing Freight Cars by the Progressive System.**

Efficient handling of material and gang organization facilitate production on the Bessemer and Lake Erie Railroad. *Railway Mechanical Engineer*, Mar. 1926, pp. 167-70. Illus. Index no. 658.542.

## Production Processes

**Cutting Ingots and Heavy Metal Masses.**

E. E. Thum. Methods whereby large masses or blocks of iron or steel may be cut to handling size by the oxygen lance. Cost data. *Forging-Stamping-Heat Treating*, Feb. 1926, pp. 57-9. Illus. Index no. 658.5.

**Industrial Furnaces—Vol. II.**

W. Trinks. John Wiley and Sons, Inc., New York. 405 pp. Illus. $5.50. Index no. 669.8. This book is a continuation of the subject developed in its predecessor, but from a somewhat different point of view. The first book is devoted largely to theory and is intended mainly for the furnace designer. The second book, now under review, is devoted primarily to practice, and therefore is intended to be useful to: (1) Those who have to decide on the type of fuel or heat energy to be used in specific cases; (2) those who select furnace equipment; (3) men who install furnaces; (4) furnace operators; (5) sales engineers for furnace equipment. To satisfy these needs descriptions of equipment form a large part of the information presented. However, the treatment is that of the handbook, which means that the work is not a mere compilation of trade catalog illustrations and data. The seven chapter headings are: Fuels and Sources of Heat Energy; Combustion Devices and Heating Elements; Control of Furnace Temperature; Control of Furnace Atmosphere; Labor-saving Appliances; Critical Comparison of Fuels and of Furnace Types; Selection of Fuel and Furnace to Suit Plant Conditions.

**Measurement of Kiln Performance.**

W. K. Lewis and A. H. Radasch. How to keep a quantitative check on kiln operation through gas analyses and other data easily procurable. *Chemical and Metallurgical Engineering,* Feb. 1926, pp. 76-8. Index no. 669.8.

**Research of Liquid Fuel Economy.**

Max Sklovsky. Manner of obtaining better economy in the application of liquid fuel to metallurgical operation in industrial production furnaces. *Forging-Stamping-Heat Treating,* Feb. 1926, pp. 60-6. Illus. Index no. 669.8.

### Material Handling

**Invading an Already Crowded Territory Successfully Accomplished.**

E. D. Roberts. Methods and material handling equipment of the Hartland Washed Sand and Gravel Co. *Pit and Quarry,* Feb. 15, 1926, pp. 53-8. Illus. Index no. 658.281.

**Material Handling Revolutionized Our Production.**

Albert Weber. Methods used by the Wilson Foundry and Machine Co. As an example of increased production, under the old method 1½ cylinder blocks were turned out per man per day. The present record is 23. *Factory,* Feb. 1926, pp. 282-4, 330, 334, 338. Illus. Index no. 658.281.

**Producing Talc at Waterbury, Vermont.**

F. A. Westbrook. Mining, manufacturing and material handling operations at the Eastern Magnesia Talc Co. Flow sheet of material is given. *Pit and Quarry,* Feb. 15, 1926, pp. 79-83. Illus. Index no. 658.281.

**Six Ways We Have Reduced Truck Expenses.**

Edward E. La Schum. Methods discussed are: Selecting equipment, training drivers, routing trucks, housing and repairs, standardizing and lubrication. *System,* Mar. 1925, pp. 368-70, 408, 410. Illus. Index no. 658.281.

**Solving Difficult Handling Problems.**

James B. Travers, asst. supt., Driver-Harris Co., tells how his plant, which has grown to its present extent through a period of years, overcomes obstacles in material handling introduced by inconvenient layout typical in the average manufacturing concern. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 287-9. Illus. Index no. 658.281.

**Trucks Handle Materials in the Foundry.**

C. C. Hermann. Illustrations and descriptions of several types of trucks at the Union Malleable Iron Co. plant, which are particularly adapted to handling materials in an iron foundry. *Foundry,* Feb. 15, 1926, pp. 135-6. Illus. Index no. 658.281.

## Employment and Personnel Management

### Personnel Management

**Employee Representation.**

Sam A. Lewisohn. American Management Association, New York. Pamphlet. 12 pp. Index no. 658.3151.

**Employee Representation as Affecting the Attitude of Labor and Business.**

Cyrus McCormick, Jr. American Management Association, New York. Pamphlet, 12 pp. Index no. 658.3151.

**The Foreman's Place in an Organization.**

J. Seton Gray. His responsibilities; need for ability to plan and for an open mind; relation to cost records; maintaining discipline; fair spirit toward men; qualifications of a foreman. *Machinery,* Mar. 1926, pp. 547-9. Index no. 658.31243.

**Some Major Aspects of Employee Representation.**

Henry C. Metcalf. Pamphlet. 16 pp. American Management Association, New York. Index no. 658.3151.

**Steady Employment Improves Morale.**

The policies of the Leeds and Northrup Co. to minimize the effect of business depressions and the accompanying improvement. *Iron Age,* Mar. 11, 1926, pp. 695-6. Index no. 658.313.

### Remuneration

**Applying Group Bonus in Toolrooms.**

Joseph Lannen. Methods used by the Paige-Detroit Motor Car Co. for measuring and applying wage incentives in the toolroom, maintenance and machine repair departments. *Machinery,* Mar. 1926, pp. 545-6. Index no. 658.3225.

**The Bonus and the Budget.**

Report for those interested in establishing and administering a bonus plan for employees as an incentive to keeping departmental expenses within the limit of the budget. Plans of three manufacturing concerns are presented: Ohio Brass Co., Ritter Dental Manufacturing Co., and Cleveland Metal Products Co. Report No. 83, Policyholders' Service Bureau. Metropolian Life Insurance Co. Pamphlet. 8 pp. Index no. 658.3225.

**Day Work vs. Piece Work.**

E. C. Dallman. Results of changeover from piece work to day work in the plant of Nunn, Bush and Weldon Shoe Co. *Society of Industrial Engineers Bulletin,* Feb. 1926, pp. 7-10. Index no. 658.3232.

**90 Per Cent Increase in Labor Efficiency.**

L. A. Sylvester. Complete details of a successful installation of group incentive for a wharf gang. Wages were increased some 25 per cent, and labor efficiency increased about 90 per cent. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 249-52. Illus. Index no. 658.3225.

### Health and Safety

**Handbook of Safety and Accident Prevention.**

Fred G. Lange. Engineering Magazine Co., New York. 512 pp. $5. Index no. 658.3823. This book contains organized grouping of factual matter dealing with accident prevention. The information is largely of practical character, showing devices, methods, systems and forms for the prevention or minimizing of accidents on the one hand, and to create the spirit of safety in working forces on the other. In addition there is a large amount of statistical information. This book appears at a particularly happy time when the interest in safety work and accident prevention is taking on a new development. Though called a handbook, it is not in handbook style; the treatment is not the compact phrasing which we associate with engineering handbooks; the page size is not the standard handbook size. The work has no contents page, nor is the material divided into either sections or chapters.

**We Cut Accidents in Half.**

F. T. MacFeely. Methods used by S. F. Bowser and Co., Inc., to reduce accidents. The keynote is "Keeping everlastingly at it." *Factory,* Feb. 1926, p. 275. Illus. Index no. 658.3823.

## Financial Control and Accounting

### Financial Control

**Applied Business Finance.**

Edmund Earle Lincoln. A. W. Shaw Co., Chicago. Third revised edition. 772 pp. $6. Index no. 658.14. Written with the aim of discussing business problems of finance which actually arise from day to day in the average industrial concern, including both manufacturing and trading enterprises. Attention is given to the influence of business cycles upon financial problems. Financing is studied in relation to original construction, purchase, production, distribution, and the consumption of goods. Developed out of the author's own study of innumerable concrete cases. Chapter headings cover: Business finance and the business cycle; normal problems of the average industrial concern; launching and organizing the business; stocks; bonds and notes; raising of capital; the investment banker; the stock market; customer and employee ownership; financial statements; financial standards; the commercial bank; the commercial paper house; trade and bank acceptances; purchasing; producing; results of size; selling; credit; distribution of earnings; financial difficulties and failures; all written with respect to their influence upon the financial side of the business.

**Interpretation of Financial Statements.**

John R. Wildman. *Journal of Accountancy,* Mar. 1926, pp. 185-95. Index no. 658.14.

**Judging Operating Results.**

Arthur Andersen. Methods employed to analyze operating statements and secure therefrom the essential facts in developing a financial and industrial investigation. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 277-80. Index no. 658.14.

**Successful Budgetary Control of Production in Fine-Paper Mills.**

H. M. Grasselt. Details of the various control budgets as applied in the industry of fine-paper making. The results from their application are given. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 257-260. Illus. Index no. 658.14.

### Accounting and Cost Finding

**Determining Shop Costs.**

[illegible] Index no. 657.452

**Cost Accounting as an Aid to Factory Production and Executive Control—II.**

[illegible] the cost accountant. *Canadian Manufacturer*, Jan. 1926, pp. 9-12. Index no. 657.452

**Cost Accounting from the Executive's Viewpoint.**

F. L. Stevens. The author, president of the Stevens and Thompson Paper Co., stresses the danger point in cost accounting when [illegible] sary information or becomes so expensive that it is an operating burden. *Paper Trade Journal*, Feb. 25, 1926, pp. 293, 295. Index no. 657.452

**Use of Standard Costs.**

[illegible] *Cost Accountants Bulletin*, Feb. 15, 1926, pp. 347-54. Illus. Index no. 657.452

## Miscellaneous

### Economics

**Economics of the Radio Industry.**

[illegible] communication has reached a stage of technical development and practical application where its legal and economic aspects must receive adequate attention. It is essentially a social agency for public service and must be handled in a manner similar to the telephone, telegraph and other means of communication. Consequently a knowledge of the economics problem raised by wireless communication is a prerequisite.

**History of Economic Progress in the United States.**

Walter W. Jennings. Thomas Y. Crowell Co., New York. 819 pp. $4.50. Index no. 33. Primarily a college textbook, although it is written in a style which may not be without interest for manufacturers, business men and general readers. Starting with the thought that history is determined by economic factors, the author divides his work into five parts, namely: Colonial Period; Winning of Expansion; War and Recovery; the Twentieth Century. The book can be recommended to manufacturers because of the way in which material is arranged and point of view taken. The amount of historical fact matter should be of particular value to anyone who is exploring the economic development of a particular manufacture or industry.

**Some Developments in the Electrical Industry During 1925.**

[illegible] electrical application and its outstanding developments during the year 1925. General Electric Co., Schenectady. Pamphlet GEA-355, 62 pp. Illus. Index no. 621.

**What Determines Wages.**

Jacob D. Cox, Jr. A plain statement of the economic laws which govern the level of wages in industry. Of particular value because it throws a new light on this controversial topic from the point of view of the manufacturing manager. MANUFACTURING INDUSTRIES, Apr. 1926, pp. 245-8. Index no. 331.214.

### General

**The Co-operative Plan in Management Engineering Education.**

[illegible] plan and comparison of term schedules for all resident and co-operative courses. *The Management Review*, Mar. 1926, pp. 67-71. Index no. 658.386

**Personnel Administration in College Curriculi.**

American Management Association, New York. Pamphlet, 168 pp. Index no. 607. Report of Committee on Relations with Colleges established to determine the scope and nature of training in personnel relations in American schools of engineering and colleges of business administration. The report is in four sections: Opinions of typical leaders in industry and education; (2) Outline of courses, typical readings and examination papers; (3) Abstracts of reports upon a questionnaire sent out by the Committee; (4) Letters expressing opinions on personnel training.

## New Industrial Equipment

**Ball-Bearing Electric Chain Hoist**

The Yale and Towne Manufacturing Company have put on the market a new ball-bearing electric chain hoist embodying such features as close headroom, long lift, higher speed, automatic top and bottom limit stops, and greater overall strength. High factors of safety in the strength of the load-supporting members and ability to withstand shock loads are provided.

The hoist can be quickly adapted to any overhead system and to fit any desired beam flange. Other features are: A constantly balanced load; compact and easily accessible mechanism fully enclosed in oil-tight chambers; ball-bearing load sheave; minimum power requirements; long life; load sheave bronze-bushed for driving pinion.

Yale electrically welded steel chain furnished for varying lengths of lift. Steel chain containers hold any length of slack chain up to 60 ft. for ¼, ½ and 1-ton hoists and 30 ft. for the 2-ton hoist. These containers do not affect the headroom. Index no. 621.1972.

**Blast Furnace Blower**

A new blast furnace blower, announced by the General Electric Co., includes three sizes of machines which cover the entire range of American blast furnace requirements. Each unit consists of a blower and a driving turbine, each rotating element being supported by two bearings and the two rotors connected through a flexible coupling.

[illegible] efficiency, multi-stage type developed about three years ago for blower and generator drive. The compressor was designed to give the most efficient velocity-pressure conversion with highly efficient cooling of the air during compression. Instead of discharge vanes, the air passages immediately beyond the impellers are specially shaped to obtain more efficient conversion of velocity into pressure and improved pressure-volume characteristics.

A constant volume governor automatically regulates the speed of the unit so as to produce the pressure required by the furnace at any instant, and this delivers air to the furnace at a constant rate, regardless of periodic changes in the resistance offered by the furnace, and also regardless of reasonable variations in steam pressure, superheat and vacuum under which the turbine is operating. Index no. 621.63

**Field Rheostats**

A series of Vitrohm and Ribohm field rheostats is offered by the Ward Leonard Electric Co.

In the Vitrohm type, high resistances make fine wires necessary. Vitreous enamel insulates the wires and conducts heat to the base of the rheostat and exposed surfaces of enamel. This construction affords a very compact rheostat construction. Mounted on pressed steel plates. Designed for mounting in the front or rear of boards in single or two-deck arrangement. Also for floor mounting and with chain and sprocket drive.

The Ribohm type consists of metal ribbons of suitable size and alloy, cut into sections, each of which is punched, formed into a channel, flattened at the ends and center, and finally bent into a V-shape. This construction gives a light weight, rigidity, unbreakable units, zero temperature coefficient of resistivity, maximum radiating capacity for a given volume, simplicity, elimination of internal wiring, and economy. Can be arranged for motor drive.

Vitrohm field rheostats come in capacities of from 24 to 32 volts, up to 320 to 600 volts. Ribohm field rheostats come in capacities of from 80 to 160 volts, up to 160 to 320 volts. Index no. 621.3174.

**Portable Vacuum Cleaner**

Exhauster constructed entirely of aluminum with two stage centrifugal or turbo type one-piece impeller. Driven by ½ hp. Westinghouse motor on 100 to 120 volts d. c. or 105 to 120 volts a. c., 25 to 60-cycle, single phase current. Special machines are supplied for 220 volts d. c. or a. c. current.

Self-aligning ball bearings, grease lubrication. Extra heavy wire wheels with rubber tires. Heavy steel welded tubing frame. Maximum vacuum 2½ in. of mercury, maximum volume 75 cu. ft. per min. Supplied with 25 ft. of rubber covered electric cord and 15 ft. of 1½ in. flexible wire reinforced hose with soft rubber connections. Equipped with blowing attachments for places inaccessible with suction nozzle. Dimensions: height 44 in., width 22½ in., length 27 in. Manufactured by Allen and Billmyre Co., [illegible] Index no. 621.57

# News of Manufacturing Industries

## The Month in Brief

**American Bosch Magneto Corporation.**—The stockholders will vote April 13 on approving the proposed sale of the company's starting, lighting and battery ignition business to the Electric Auto-Lite Company.

**American Brake Shoe & Foundry Co.—**

| Calendar Years | 1925 | 1924 |
|---|---|---|
| *Net profits | $2,786,607 | $2,454,905 |
| Preferred dividends (7%) | 667,695 | 667,695 |
| Common dividends | ($5¼)829,900 | ($5)789,599 |
| Divs. paid by sub. cos | 300 | 11,617 |
| Balance, surplus | $1,288,712 | $985,994 |

* Net profits from operation of plants are shown after deducting manufacturing, administration and selling expenses and depreciation of plants and equipment and including dividends received on stocks of associated companies whose earnings are not incorporated herein and other income (net) less estimated Federal taxes.

**The American Bridge Company** has received a contract for between 18,000 and 20,000 tons of structural steel to be used in erecting the Union Terminal tower at Cleveland.

**American Locomotive Company** has recently closed contracts for 23 locomotives for the Southern Pacific Railroad and 23 others for the Florida East Coast Railroad. The two contracts total approximately $4,000,000 and give the company a total of $22,000,000 unfinished business on its books. The plants of the American Locomotive Company operated on a smaller scale last year than in any other year since the organization of the company in 1921, due to the lack of orders for both domestic and foreign account.

**Bausch & Lomb Optical Company.**—Herbert Eisenhart, Joseph H. Hammerly, Carl S. Hallauer, Theodore Drescher, Carl S. Bausch and J. F. Taylor have been elected directors. Mr. Eisenhart has also been elected a vice president to succeed George N. Saegmuller, and will be associated with Vice-president Edward Bausch in the general management of the business. Mr. Eisenhart will serve as an assistant to Mr. Bausch.

In the will of John Jacob Bausch, founder of the company, who died on February 14, a trust fund of $100,000 was created to be used for employees' benefit.

**Bausch Machine Tool Company.**—The company has cancelled 1,123 shares of preferred stock, par $100, purchased for the sinking fund, thus reducing the outstanding capital stock to $387,700 preferred and 50,000 shares of common stock, no par value.

**J. G. Brill Company.**—The newly elected officers are Samuel M. Curwen, president; E. P. Rawle, treasurer; J. W. Rawle, vice president, and E. E. Oerter, secretary.

**California Petroleum Corp.**—The corporation has acquired the California Gasoline Corp., a large producer of casinghead gasoline, for approximately $5,000,000. The five absorption plants of the California Gasoline Corp. located in the Signal Hill, Huntington Beach and Athens field, are said to have a present daily production of 60,000 gallons of natural gasoline. With the addition of this output, the California Petroleum Corp. will have a daily production of natural gasoline amounting to 110,000 gallons. The six casinghead plants already owned by the California Petroleum Corp. are located in the Signal Hill, Santa Fe, Huntington Beach, Montebello and Ventura fields.

**Caterpillar Tractor Company.**—The sales of the company and its two predecessors for 1925 total approximately $20,800,000. Earnings for the same period before Federal income taxes and interest charges amounted to approximately $4,400,000. Cash and certificates of deposit as of December 21, 1925, total about $1,400,000. The current liabilities consisted only of current accounts payable aggregating approximately $600,000.

**The Columbia Steel Company** has been formed through a merger of the Forged Steel Wheel Company, subsidiary of the Standard Steel Car Company, and the Columbia Steel Company of Elyria, Ohio. The Columbia Steel Company of Elyria was acquired through 100 per cent stock control by the Forged Steel Wheel Company.

The new concern plans expenditure of several million dollars in the construction in Butler, Pa., of a thirty-inch hot and thirty-inch cold strip mill, with auxiliary equipment. Plans for the new plant provide for the manufacture of the widest steel ever made on a strip mill. Through a continuous annealing process a product named "strip sheet" will be made thirty inches wide, equivalent to the grade of sheets fit for the manufacture of automobiles. The capacity of the mills will be 20,000 tons a month.

**Continental Oil Company.**—The company, it is announced, has acquired the Texhoma Oil and Refining Company including a refinery with a capacity of 5,000 barrels of oil a day, in addition to large producing acreage. It is understood that the price paid for the majority stock interest in Texhoma Company was approximately $125 a share. The Continental Oil Company is now producing more than 25,000 barrels of crude oil daily.

**Dodge Brothers, Inc.**—Earnings in 1925 established a record for the company, according to the annual report. Net income after depreciation, but before interest on funded debt and Federal taxes, including earnings for the first four months of the year by the predecessor company, was $28,698,846, against $19,965,440 in 1924. Included in the figure for 1925 are earnings of Graham Brothers subsequent to the acquisition in October. Graham Brothers earnings after depreciation and all charges, except Federal taxes, for all 1925, amounted to $4,966,236.

The net of $28,698,846 is equal after taxes and full year's interest on debentures, and dividend requirements on preference stock outstanding Dec. 31, to $6.59 a share on the Class A and Class B common stock.

**E. I. duPont de Nemours & Company.**—The directors on Feb. 15 declared a quarterly dividend of 2½ per cent on the common stock, par $100, payable March 15. In the previous two quarters, the company paid regular dividends of 2 per cent on the common stock, and in addition an extra of 1 per cent on Sept. 15 and one of 5 per cent on Jan. 8 last.

**Fairbanks, Morse & Company.**—The directors have declared four quarterly dividends of 75 cents each on the common stock, payable March 31, June 30, Sept. 20 and Dec. 31. From June 30, 1924, to Dec. 31, 1925, inclusive, the company paid quarterly dividends of 65 cents per share on the common stock. Preliminary figures indicate a net profit of approximately $3,000,000 for 1925 after depreciation and Federal taxes, compared with $2,156,838 in 1924.

**Ford Motor Company.**—Purchase of 1400 acres at Maynard, Ind., for an airport has been completed by placing the deeds on file. The tract includes 1000 acres in Indiana and 400 in Illinois. It is expected that part of the site will be used for airplane manufacture.

A $3,000,000 factory for the manufacture of upholstery cloth and head lining used in its automobiles will be built in Washtenaw County, near Ypsilanti. Construction will begin April 15. To provide power to operate the factory, which is to be completed in two years, a dam will be built across the Huron River, creating a five-mile lake. In the manufacture of Ford cars last year 3,947,855 square yards of both materials were required, 2,225,509 yards being used for upholstering. The company estimated that the wool of 2,500,000 sheep was needed for last year's cloth.

"We never know how *little* we make (or save), until we know how *much* we WASTE"

# "Waste Elimination Week"

## THE ISSUE

According to a Bulletin, "Elimination of Waste," of the Department of Commerce, *average waste in American business is 49%.*

It states that according to surveys made by Federated American Engineering Societies, waste in six leading industries is as follows: Metal trades, 29%; Boot and Shoe, 41%; Textiles, 49%; Building, 53%; Printing, 58%; Men's Clothing, 64%.

It also states that based on 1922 figures, *waste in industry* yearly is *equal to* the Federal, State and Municipal *taxes, plus* the cost of *automobiles, gasoline,* and *homes* built in the United States.

## THE CALL TO SERVICE

Before the Chamber of Commerce of the State of New York, November 19, 1925, President Coolidge said:

". . . We need still further effort against all the various categories of waste which the Department of Commerce has enumerated and so vigorously attacked, and in this direction lies not only increased economic progress, but the maintenance of that progress against foreign competition. There is still plenty for business to do."

The Hoover Committee on Elimination of Waste in Industry, in calling attention to the work of Waste Elimination said:

"There will be need of both cooperative and individual effort. As regards groups, each must frankly face its own responsibility and meet its own duties. Each individual—plant executive or worker—must discover his own opportunities and then accept responsibility for performance."

In his last annual report, Secretary of Commerce Hoover said:

"Just as twenty years ago we undertook nation-wide conservation of our natural resources, so we must today even more vigorously sustain this campaign of nation-wide utilization of our industrial resources and effort."

## "WASTE ELIMINATION WEEK"

For a long time we have been at work on the development of a service aimed to secure results in the elimination of waste in industrial plants, by focusing the attention of a plant's personnel in an intensive way, on the problem of waste.

What waste is; its extent in a calculated or estimated way; the means for organizing to give attention to it; placing the facts before employees and getting their cooperation; and developing a program of Waste Elimination, are some of the chief factors which would be considered by the proposed service.

An official of one of the largest engineering societies, wrote to Mr. Knoeppel on this subject, saying:

"I have read with keen interest and appreciation the program for 'Waste Elimination Week,' and it occurs to me that this is the real way to get after the waste problem in American Industry. I therefore hope you have a large response."

*May we submit specifications which we have prepared, covering the service for "Waste Elimination Week," if you are desirous of attacking the waste problem in a result-producing way?*

# WASTE ELIMINATORS

INCORPORATED

C. E. KNOEPPEL, *Managing Director*

PARK SQUARE BUILDING BOSTON, MASSACHUSETTS

*Division of Bigelow, Kent Willard & Co., Inc.*

# Invigorate Production!

*Invigorate* your employees — *invigorate* their capacity for work—*invigorate* production with clear, clean water from Rundle-Spence Vertico-Slant Fountains.

Drinking sanitation is positively enforced. The contamination of lip-contact is eliminated. The slight-slant stream prevents water from falling back upon the jet, and is just right for easy and convenient drinking. R–S Vertico-Slant Fountains check the waste of water, give years of continuous service, and may be had with body coolers if desired.

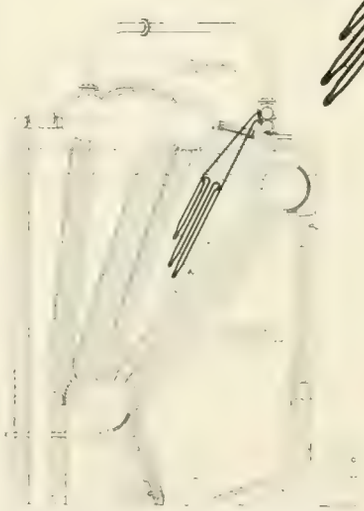
The R–S line includes Sanitary Drinking Fountains, Bath and Plumbing Fixtures and Supplies. Write for catalog with complete information.

RUNDLE-SPENCE MFG. CO.

62 Fourth Street Milwaukee, Wis.

RUNDLE-SPENCE

# Elesco Engineering for the Connelly Semi-Vertical Boilers



Elesco Superheater in a Connelly Semi-Vertical Boiler. This arrangement is covered by Bulletin T–10–Connelly. May we send you a copy?

In this type boiler the triangular space between the first and second banks of tubes is utilized for the superheater. The temperature of the gases in this location is sufficient to secure a high superheat with a reasonable amount of heating surface. When a baffle is located in front of the superheater the gases are prevented from by-passing the second pass bank of tubes and thus the efficiency of this pass is increased. The exit gas temperature is thereby decreased and the efficiency of the boiler increased.

There are so many factors entering the application of superheaters to boilers that the value of a specialized engineering service such as Elesco offers is of invaluable aid to power engineers.

Advise the make and style of boiler which you have and we will send you a copy of the bulletin on Elesco superheaters applied to this particular construction.

*This is one of a series of advertisements covering Elesco superheaters for various makes of boilers*

THE SUPERHEATER COMPANY

17 East 42nd Street NEW YORK — Peoples Gas Building CHICAGO

Boston — Pittsburgh

Canada: The Superheater Company, Limited, Montreal


**General Electric Company.**—Thirty employees received awards in recognition of outstanding performance during 1925. Each includes a Charles A. Coffin Foundation Certificate of Merit and a honorarium of $300. Those who received the 1925 awards include:

### SHOP MEN

Henry Klammer, repair man, induction motor department, Schenectady. Developed apparatus which makes the winding of the induction motor coils by machinery possible.

Alexander Iwanowicz, wire insulator, Pittsfield. Devised a spiral method of applying cotton insulation to small sizes of wire.

Frank L. Coombs, machine operator, wire and insulation department, River Works, Lynn. Improved machinery for treating canvas duck with bakelite.

Raymond Z. Woluns, winder, winding department, Windsor works. Devised new method of insulating bipolar type of machine-wound armatures.

Alfred H. Burchard, master mechanic, Niles glass works. Developed, with K. A. Reider, method for commercial production of new inside-frosted incandescent lamp bulbs.

Charles W. Craig, machinist, Cleveland incandescent lamp works. Designed and constructed with Frank B. Van Sickle water-cooled gathering ram for use with bulb machine.

Frank B. Van Sickle, machinist, Cleveland incandescent lamp works. Designed and constructed, with Charles W. Craig, a water-cooled gathering ram for use with bulb machine.

Michael McGowan, mechanic, Harrison incandescent lamp works. Developed method for holding mica discs in higher wattage lamps.

### FOREMEN

August Kayser, tool designer, Fort Wayne works. Designed very special and highly automatic machines for completely machining meter bases.

Thomas McGuckin, construction foreman, Light, Heat and Power Department, Schenectady. Designed and developed set of fixtures for factory wiring installations.

Joseph W. Kessler, general foreman, molded insulation department, Pittsfield. Increased the output of his department by approximately 60 per cent because of increased efficiency following a general economy in manufacturing processes.

Rudolph Hillner, foreman, turbine department, Schenectady. Developed fixtures for milling turbine parts, resulting in improved products at lower costs; also developed fixtures which simplified and speeded production of radio parts.

John F. Heath, foreman, motor department, Schenectady. Developed method for use of straight bar construction in some sizes of wound rotors for induction motors.

Dennis F. Madden, foreman, searchlight department, Schenectady. Developed and

*(Continued on page 303)*

# Construction and Equipment *for* The Modern Plant

NEW manufacturing buildings are a tremendous improvement over those erected even five years ago. A few features of design and construction are: Layout to give greatest economy of production; horizontal flow of work rather than vertical; material handling equipment planned as part of the layout; illumination, heating, ventilation, dust removal scientifically studied; no strip wood floor used; fire-resisting materials employed even for details. These and other features are recognized today as necessary to get low production costs and quality output.

The materials, construction and equipment indexed below and advertised in the following pages are being installed in modern manufacturing plants which are striving for improved operation and lowest production costs.


| | PAGE |
|---|---|
| Blue Printing Equipment<br>C. F. Pease Company | 302 |
| Boxes<br>Hinde & Dauch Paper Company | 317 |
| Copper and Brass<br>Copper and Brass Research Ass'n | 307 |
| Glass, Wired<br>Mississippi Wire Glass Company | 304 |
| Grinding Machinery<br>Norton Company | 312 |
| Hangers, Shaft<br>Shayef Ball Bearing Company | 319 |
| Instruments, Recording<br>Taylor Instrument Company | 309 |
| Motors, Electric<br>General Electric Company | 320 |
| Paints and Painting Equipment<br>Vortex Manufacturing Company | 308 |
| Tiering Machines<br>Economy Engineering Company | 310 |
| Time Recorders<br>Calculagraph Company | 305 |
| Trucks, Industrial<br>Mercury Manufacturing Company | 303 |
| Steubing-Cowan Company | 307 |
| Valves<br>Jenkins Brothers | 304 |
| Ventilating and Power Equipment<br>Buffalo Forge Company | 307 |
| Wire Binding<br>Gerrard Wire Tying Machines Co. | 313 |

# A Challenge

## To every blue print maker in the world

**Do you realize** the savings in time and money that the Pease Peerless Blue Printing equipment can make? Did you ever see the excellent reproductions it turns out? Do you know why it is enabling makers of blue prints in any quantity, large or small, to reduce their costs? We know all these things—perhaps you don't.

**Therefore we challenge** every blue print make—not now using Pease Equipment—to a comparative test. We'll pit the Pease equipment against your present method; we're confident the results will be so overwhelmingly in favor of the Pease, that no further discussion will be necessary.

Just write us for further particulars and a copy of our catalog M-23 giving all the facts—remember you'll be under no obligation.

**The C. F. Pease Company**
**823 N. Franklin St., Chicago, Ill.**

# PEASE
## BLUE PRINTING MACHINERY

put into effect numerous improved manufacturing methods.

Helge E. Carlson, foreman, street lighting department, River Works, Lynn. Developed coil-winding machine which has resulted in greatly increased production with one-half the floor space and equipment formerly used in manufacture of Tungar rectifiers.

Kenneth A. Reider, foreman, Niles glass works. Developed, with A. H. Burchard, method for commercial production of new inside-frosted incandescent lamb bulbs.

ENGINEERS

Svend Johannesen, developmental engineer, Pittsfield. Redesigned distribution transformers and developed winding machine and special tools for their production.

Walter W. Brown, engineer, Erie works. Improved method of manufacturing controller parts.

Peter P. Alexander, research worker, Thomson Research Laboratory, River Works, Lynn. Developed method for producing ductile arc weld.

C. W. Place, engineer, Chicago office. Unusual initiative in working out plans for development of hydroelectric power.

Charles Deshler, technical supervisor, Harrison incandescent lamp works. Developed improved methods of photometering incandescent lamps.

Robert N. Falge, commercial engineer, Cleveland incandescent lamp works. Developed depressible-beam system of automobile headlighting.

Marvin Pipkin, chemical engineer, Cleveland incandescent lamp works. Devised practical method of frosting the inside surface of incandescent lamp bulbs.

Chester I. Hall, engineer, Development Laboratory, Fort Wayne. Developed the induction disc motor for the driving of talking machines, demand meters, time switches and similar devices.

COMMERCIAL

Thomas L. Miller, salesman, central station department, Dallas office. Displayed unusual ability and initiative in certain novel and highly effective sales work.

William J. Bray, salesman, industrial department, Chicago office. Expanded his field of work by stimulation of interest in solution of engineering problems.

Alta R. Tanner, general salesman, San Francisco office. Provided effective method of drawing attention to the Home Electrical idea.

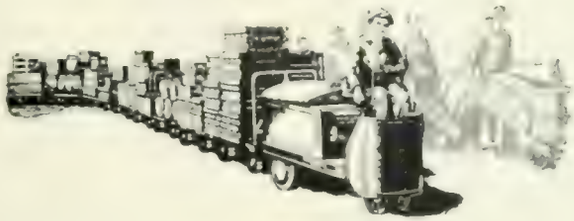
Leonard L. Asch, clerk, switchboard device sales, Schenectady. Devised film depicting construction and operation of products switchboard department, constituting a method of supplementing other sales effort.

Robert W. Adams, manager of Providence office. Proposed the personal rating sheets plan which has been adopted by the company.

*(Continued on page 304)*


# Mercury

[ This is No. 4 of a series ]



## We Can't Solve All Your Problems!

We do not claim that our equipment —of itself—will entirely solve your plant transportation difficulties. We know that labor saving equipment must first be intelligently selected and applied.

This careful selection and wise application is the province of you men who are making it your sole business to reduce the production costs of your respective establishments.

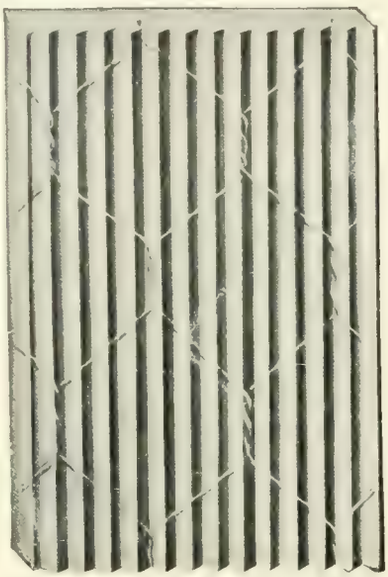
However, we do contend—and this contention is supported by thousands of satisfied Mercury users—that for the *horizontal movement* of goods—(and this movement is common to all factories and comprises 90% of all handling)—no method can approach in efficiency and low cost a well planned and properly supervised *tractor-trailer system.*

Mercury makes a complete line of tractors and trailers. Our sales engineers are, by ability and experience, fitted to be of real help to you in selecting the right equipment.

**Mercury Manufacturing Company**
**4124 So. Halsted St. Chicago, U. S. A.**

# Tractors and Trailers

# PENTECOR WIRE GLASS



Made in both Plain and Wire Glass

For skylights, this is the best type of glass to install, because it is scientifically designed especially for skylights to conduct condensation and transmit the maximum amount of daylight.

There is no glass which will give better light distribution in skylights than Pentecor. It is no more expensive than Rough or Ribbed, so why not get the best and reduce the cost of artificial illumination?

**MISSISSIPPI GLASS CO.**
**MISSISSIPPI WIRE GLASS CO.**
**220 FIFTH AVENUE**
**CHICAGO, ILL.. NEW YORK ST. LOUIS, MO.**

# For water softeners

Jenkins Valves are important items of the DecAlso water softener, manufactured by the American Water Softener Co., Philadelphia, Pa.

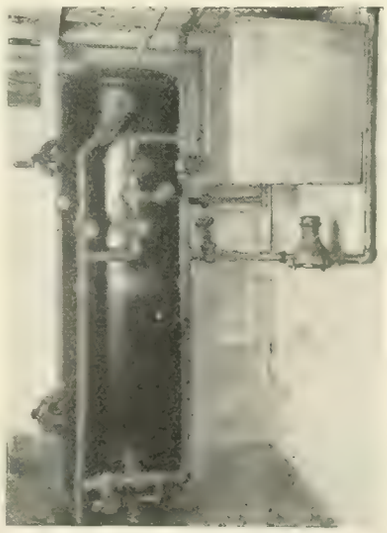
Jenkins Valves are built for the maximum service, not merely the average. Their use contributes to the reliable performance of a piece of apparatus.

The sales engineering department of Jenkins Bros. has served many equipment manufacturers, and is always willing to aid in the selection of proper valves for any type of equipment

*JENKINS BROS.*

*80 White Street.....New York, N. Y.*
*524 Atlantic Avenue.....Boston, Mass.*
*133 No. Seventh Street.....Philadelphia, Pa*
*646 Washington Boulevard.....Chicago, Ill*

*JENKINS BROS., Limited*
*Montreal, Canada London, England*



*DecAlso domestic type softener, manufactured by the American Water Softener Co., Philadelphia, and equipped with Jenkins Valves*

Always marked with the Diamond"
Jenkins Valves
SINCE 1864


ADMINISTRATIVE

Herbert L. Whittier, accountant, Erie Works. Originated method of estimating expense allowances to cover varying volumes of production.

**General Motors Corporation.**—The directors on Feb. 11 declared a quarterly dividend of $1.75 per share on the common stock payable March 12. During 1925 the company paid four quarterly dividends of $1.50 each and an extra of $1 per share on the common stock. An extra dividend of $5 per share was also paid on Jan. 7 last. President Alfred P. Sloan, Jr., following the meeting of the directors, said in substance: Net earnings for 1925 amounted to $115,980,099. After allowing for dividends on the preferred stocks, there was a balance of $108,340,108 for the common stock, equal to $20.99 a share. This includes $9,509,722 which is the corporation's proportion of the earnings of subsidiary operations in excess of dividends actually received. Cash on hand and in banks together with marketable securities, government and otherwise, amounted to $145,142,087 at the close of 1925.

**B. F. Goodrich Company.**—The report of the B. F. Goodrich Company for 1925 shows net sales of $136,239,526, against $109,817,685 in 1924. After allowing for all expenses and reserves for depreciation, interest and taxes, and a special reserve of $4,000,000 to cover possible losses due to fluctuations in crude rubber prices, the company reported net profit of $12,744,447, against $8,822,504 in 1924.

The consolidated income account for 1925 and 1924 follows:

| | 1925 | 1924 |
|---|---|---|
| Net sales | $136,234,526 | $109,817,685 |
| Manufacturing expense | 113,860,422 | 95,952,161 |
| Profit | $ 22,379,104 | $ 13,865,524 |
| Other income | 1,020,035 | 865,642 |
| Total income | $ 23,299,139 | $ 14,731,166 |
| Depreciation | 2,377,192 | 2,547,434 |
| Interest, etc | 1,927,500 | 2,361,228 |
| Federal taxes | 2,350,000 | ... |
| Reserve | *4,000,000 | 1,000,000 |
| Net profit | $ 12,744,447 | $ 8,822,504 |
| Preferred dividends | 2,314,620 | 2,460,150 |
| Common dividends | 1,202,800 | ... |
| Surplus | $ 9,227,027 | $ 6,362,354 |
| Earned surplus | 24,770,124 | 17,609,966 |

*Set up for contingencies and to cover possible losses due to fluctuation in prices of raw materials.

**Greenfield Tap & Die Corporation.—**

| Assets | 1925 | 1924 |
|---|---|---|
| Plant and equip., etc | $4,291,711 | $4,294,109 |
| Cash | 405,473 | 442,302 |
| Notes and acc'ts rec | 416,398 | 417,916 |
| Inventories | 2,812,606 | 2,917,711 |
| Prepaid expenses | 39,768 | 49,496 |
| Investments | 330,087 | 329,172 |
| Deferred assets | 48,910 | 39,898 |
| Good-will | 1,068,813 | 1,068,813 |
| Patents and trade marks | 151,641 | 151,569 |
| Total | $9,565,408 | $9,710,986 |

| Liabilities | 1925 | 1924 |
|---|---|---|
| Common stock | $3,248,825 | $3,248,825 |
| 8% preferred stock | 3,112,000 | 3,112,000 |
| 6% preferred stock | 35,000 | 35,000 |
| Notes payable | 1,500,000 | 1,800,000 |
| Accounts payable | 55,612 | 17,196 |
| Reserve for depreciation | 1,059,724 | 992,134 |
| Other reserves | 244,815 | 118,990 |
| Surplus | 309,422 | 386,837 |
| Total | $9,565,408 | $9,710,986 |

*(Continued on page 306)*

# Superintendents Increase Shop Output with these *Elapsed Time* Records

Absolutely accurate records of *elapsed time* for every workman on the job—these are a necessity in all modern production where economy is required.

In the office, the factory accountant uses Calculagraph to eliminate all the pay roll losses.

In the shop, the up-to-date Superintendent uses Calculagraph as a perfect instrument for checking up and gauging the speed and productivity of his men —all of them, or any one—at a glance!

Let us send you literature telling how Calculagraph does all this—how Calculagraph prints *on any style of time ticket* the automatically-computed total of working time elapsed together with time of beginning and ending every job, for any number of workmen. Write today for your copy of *Elapsed Time Records*.

**The Calculagraph Company**

**50 Church Street Dept. 12 New York City**

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*The Elapsed Time Recorder*

*if —*

you are interested in why your company should advertise in this magazine write immediately for the second BOOK OF FACTS which will surely interest you.

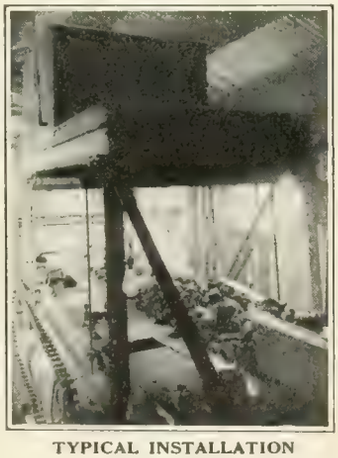
RUTLEDGE BERMINGHAM
*Advertising Manager*

**SAVE TIME AND LABOR**

USE THE

# Merrick Conveyor Weightometer

Any material handled on a belt, bucket or pan conveyor fitted with **MERRICK WEIGHTOMETER** is automatically weighed as it moves along. The scale is always on the job—it makes no slips—it's honest—and its totals at the end of the day are accurate and they require no special attendant.



TYPICAL INSTALLATION

***Material being handled over Weightometers***

| | |
|---|---|
| COAL | FERTILIZER |
| ORES (all kinds) | PHOSPHATES |
| CEMENT | SAND |
| SHALE | PAPER MILL PRODUCTS |
| CLINKER | HOG FUEL |
| ROCK | SALT |
| GYPSUM | ETC., ETC. |
| FISH | |

**MERRICK SCALE MANUFACTURING CO.**

186 AUTUMN STREET, PASSAIC, NEW JERSEY

**Hayes Wheel Company** reports a net profit for 1925 of $1,719,005 after charges and federal taxes, equivalent, after preferred dividends, to $8.02 a share on the 197,944 shares of no par common and compares with earnings of $715,264 or $3.16 a share in 1924. Current assets at the end of the year were $5,618,066, including $2,503,972 in cash as against $1,011,479 in current liabilities. Bonds were reduced over $400,000 to $559,100 and the remainder was retired Feb. 1. The company also retired 1,984 shares of preferred, reducing the total to $1,639,800.

**International Business Machines Corporation.**—The directors have declared a quarterly dividend of 75 cents per share on the new common stock of no par value, payable April 10 to shareholders of record March 23. This is equivalent to $9 per share per annum on the old common stock which was split up on a 3 for 1 basis, and on which dividends at the rate of $8 per share had been paid. The company also paid a 20 per cent stock dividend on the old stock on Dec. 15 last.

**Jackson Mills of the Nashua Manufacturing Company**, which has been operating four days a week for some time, will operate until further notice on a five-day week schedule, or 50 hours a week.

**The Leather Company.**—A corporation known as The Leather Company has been formed to facilitate reorganization of the Graton and Knight Manufacturing Company. The Leather Company will purchase the assets of the present company and upon completion of the reorganization transfer these assets to the new corporation.

**Loose-Wiles Biscuit Company.**—Report of Loose-Wiles Biscuit Co. for year ended December 31, shows net profit of $1,413,095 after interest, depreciation and federal taxes, equivalent after regular preferred dividend requirements and amounts appropriated for redemption of first preferred stock, to $10.39 a share earned on $8,000,000 common stock. This compares with $1,177,204 or $7.42 a share in 1924.

**Milwaukee Electric Crane & Manufacturing Corporation** shipped one of the largest orders for lumber handling machinery that has ever been placed. Included are 32 electric cranes. The destination is the Long Bell Lumber Company, lumber operators in Washington.

**National Fireproofing Company.**—

| Calendar Years | 1925 | 1924 |
|---|---|---|
| Net earnings after all charges and taxes | $ 813,091 | $ 971,338 |
| Depreciation and depletion | 303,388 | 299,591 |
| Preferred dividends (5¼%) | 414,776 | (6) 474,030 |
| Balance, surplus | $ 94,927 | $ 197,717 |
| Profit and loss, surplus | $2,013,919 | $2,028,927 |

**Nugent Steel Casings Company.**—H. C. Osman, sales manager, has been elected sec-

*(Continued on page 308)*

# Cutting down the after-cost

After-cost enters the reckoning wherever rust takes toll.

At first BRASS pipe costs more than corrodible pipe. But BRASS is rust free. That makes it free of after-cost.

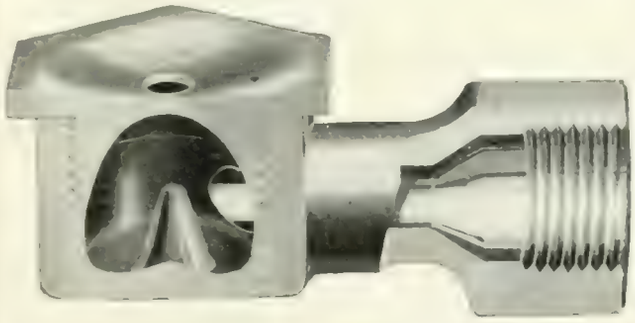
The same is true of COPPER work.

Where COPPER is installed for roofing, roof drainage, or other appropriate service in office, plant or home, there is no after-cost.

COPPER & BRASS
RESEARCH ASSOCIATION
25 Broadway, New York



# New features make Carrier Air Washers better than ever—

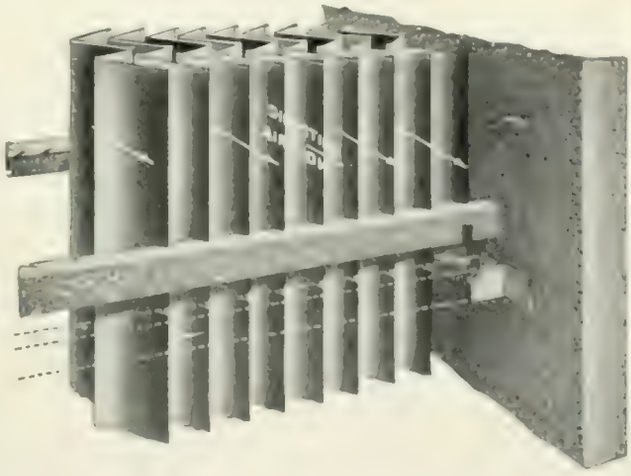


Recent improvements have added to the Carrier Air Washer longer life, higher efficiency, easier erection and still simpler maintenance.

We've made these improvements at no increase in prices, making Carrier Air Washers better than ever.

For supplying clean, tempered air in offices, factories, schools, theatres, and public buildings, no equipment gives such universal satisfaction as the Carrier Air Washer. This widespread popularity is due to the simplicity of the Carrier Washer, its long life, its perfect spraying system, excellent washing surface and low frictional resistance to air.

With a Carrier System installed in your building you have year-'round control of the atmosphere; in winter the temperature inside may be kept where you want it, regardless of the weather, while in summer you can reduce the temperature in your building from 10° to 16°. And remember—the Carrier System is the only one to give these results and is sold with a guarantee of satisfaction.



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Carrier Air Conditioning Company

141 Mortimer Street Buffalo, New York

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## Made for Gunning

ALL fine paints are not equally adapted to paint gun application.

That is why, in adopting the marvelous saving and efficiency of modern gun painting, you should choose Vorcolite which, for twelve years has filled the demand for a full bodied white oil paint of the highest quality made especially for the pneumatic paint gun.

The gun, too, is loaned without cost, to purchasers of Vorcolite. Paint and gun together bring you

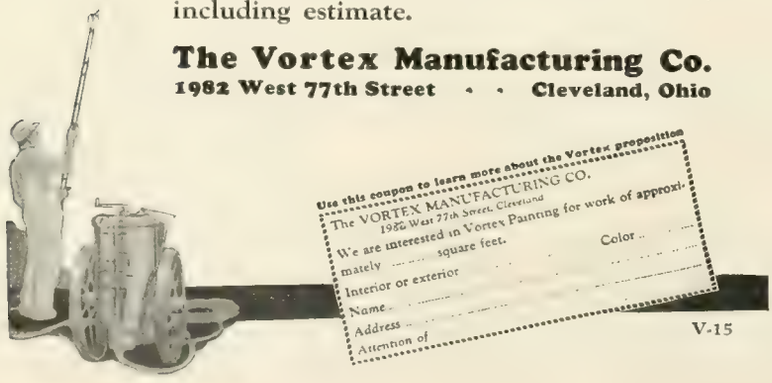
## VORTEX
## Painting Method

*used only in the maintenance painting of large surfaces*

There is no compromise about Vorcolite. It is especially prepared for mechanical application with rich, lasting pigment selected for maximum coverage and light reflection. The paint vehicle is compounded after long experience with gun painting, not only to assure smooth discharge, but to afford a smooth, rich paint on the wall—a flat white that covers with a single application.

**Vortex Painting Carries Through**—Our paint, our gun, your unskilled labor assure a quicker, better, more convenient and economical job than a whole squad of hand painters. The attached coupon, filled out and mailed, will bring you the whole proposition, including estimate.

**The Vortex Manufacturing Co.**
**1982 West 77th Street • • Cleveland, Ohio**



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Interior or exterior .....
Name .....
Address .....
Attention of .....
V-15


retary of the company. He will continue to have charge of the sales. C. A. MacDonald was elected treasurer, at the same time resigning the office of secretary which he had held for some time.

**Phoenix Hosiery Company.—**

| Calendar Years | 1925 | 1924 |
|---|---|---|
| Net income | $2,170,173 | $ 480,722 |
| Interest paid | 102,640 | 167,694 |
| Federal and State taxes | 415,593 | 42,800 |
| Divs. on 7% preferred stock | 294,460 | 305,893 |
| Common dividends | | |
| Surplus | $1,357,480 | def$35,665 |
| Previous surplus | 3,870,402 | 3,982,511 |
| Total surplus | $5,227,882 | $3,946,846 |
| Unused portion reserved for contingencies (*Cr.*) | | |
| Profit on redemption of preferred stock (*Cr.*) | 10,291 | 16,753 |
| Depreciation for year | 93,197 | 93,197 |
| Profit and loss surplus | $5,144,975 | $3,870,402 |

**Pratt & Lambert, Inc.** for 1925 reports net profits of $1,336,657, the largest for any year in the history of the company. The total compares with profits of $1,144,442 in 1924. The net profit for 1925 was equal to $6.60 a share earned on the 202,500 shares of no par value common stock outstanding after preferred dividend requirements, against $5.36 a share in 1924.

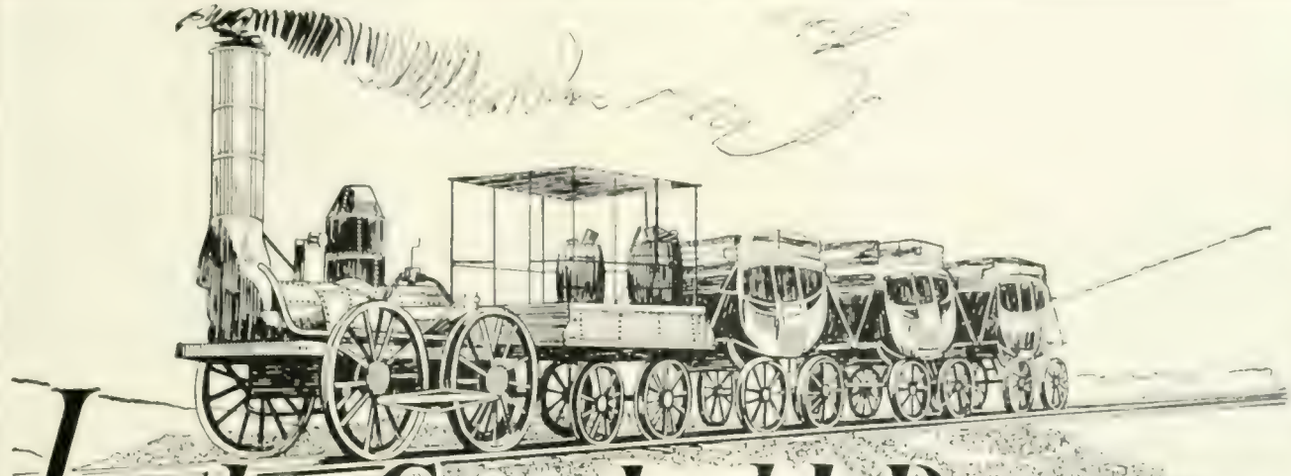
**Pressed Steel Car Company.**—The stockholders on Feb. 18 approved the merger with the company of the Western Steel Car & Foundry Company.

**Pure Oil Company.**—The company has announced an offering of its 6 per cent preferred stock to employees, who are permitted to subscribe to not less than 5 per cent nor more than 25 per cent of an amount equal to four times their present yearly salaries. Payment will be made by salary deductions only in 96 equal semi-monthly installments over a four-year period. Subscribers will receive 8 per cent interest yearly on entire amount of their subscriptions and will pay 6 per cent on the unpaid balance. When payments are completed at the end of the four-year period, the company will pay an additional cash bonus of 25 per cent of the amount of stock subscribed for.

The company reserves the right at the end of the four-year term to return the full amount of the deposit in cash plus the 25 per cent premium. This is the company's fifth sale of stock to its employees.

**Rolls-Royce of America, Inc.**—Henry J. Fuller, president of Rolls-Royce of America, Inc., announced yesterday that sales of the company had been larger in 1925 than at any previous period and that orders were being received at double the rate of a year ago. The plant at Springfield, Mass., is operating with an extra force at night and is sold four months ahead. On Jan. 1 the company acquired the plant of Brewster and Company, of Long Island City to increase production. It is anticipated that eventually the Rolls-Royce-Brewster organization will be increased to 5000 or 6000 employees.

*(Continued on page 311)*



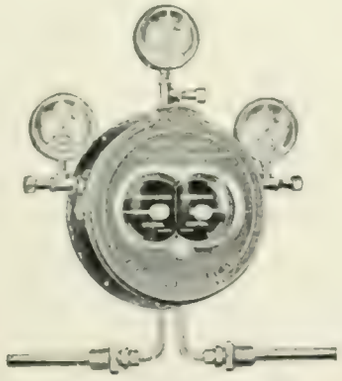
# In the Good old Days of "Rule of Thumb"

WHEN the famous "De Witt Clinton" made its memorable runs on the old New York Central, manufacturers were of necessity addicted to rule of thumb methods. Great skill and initiative on the part of the laborer were the only factors that prevented huge losses of material subjected to any kind of process work.

To-day science rules industry. No longer can you afford to depend on the skill of the workman. You must enlist the aid of exact methods if you wish to manufacture uniform, always dependable product.

Tycos temperature instruments—indicating, recording and controlling—take the guessing out of all process work. Step by step, and at every instant, they enable you to duplicate *exactly* the results of any previous batch of work.

Ten thousand industries now use Tycos. Our ample engineering staff is at your disposal to study your special requirements. May we send a catalog of instruments particularly adapted to your needs?



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## Taylor Instrument Companies

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CANADIAN PLANT TYCOS BLDG., TORONTO

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# Tycos Temperature Instruments

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Colonel C. deF Chandler

The first comprehensive, organized Library of practical aeronautics in any language. Of great importance to manufacturers, not only because of the rapidly growing use of commercial aircraft and consequent manufacturing possibilities, but also because gases, materials employed in aircraft construction, and instruments for indicating speed, pressure, etc., are constantly used in manufacturing processes and should be understood.

The Library embraces *aerostation* as well as *aviation*, together with correlated subjects. It will include volumes on aircraft power plants, balloon and airship fabrics, airports and airways, and other subjects of like interest as required.

The Editor of this Library is Lieut. Colonel C. deF. Chandler, U. S. Army, Retired (Colonel U. S. Air Service, Res.); well known as one of the pioneer balloon and aviation pilots of this country; Commanding Officer of the first Army Aviation School at College Park, Md.; Later Chief of the Balloon Section for the American Expeditionary Force in France.

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**Standard Oil Company of Louisiana.**—Cal K. Clark, senior vice president, has been elected president, succeeding D. R. Weller.

**Tide Water Oil Company.**—Consolidation of the Associated Oil Company and the Tide Water Oil Company into one organization brings about the formation of another large independent unit in the industry, with total assets of $240,000,000.

The new company will acquire all the assets of the Associated and Tide Water organizations.

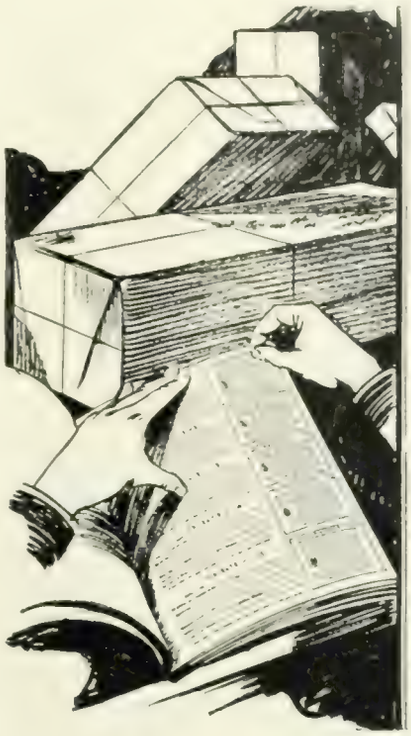
The new Tide Water Associated Oil Company has an authorized capital of 1,500,000 shares of 6 per cent cumulative preferred stock, of which 763,471 shares will be outstanding, and 10,000,000 shares of no par value common stock, of which 5,480,733 shares will be outstanding.

**Timken-Detroit Axle Company.**—The common stock of the Timken-Detroit Axle Company was placed on a 6 per cent annual dividend basis with the declaration of a 1½ per cent quarterly dividend, payable April 1. This is the first dividend to be paid by the company since 1921, when a distribution of 2 per cent was made to stockholders.

**United States Steel Corporation.**—Feb. 25 was the twenty-fifth anniversary of the organization of the United States Steel Corporation. The first official balance sheet showed total assets of $1,500,000,000; assets today are $2,500,000,000. The increase in value has come from accumulated profits put back into the property. During this quarter century the corporation has paid out $1,279,953,785 in dividends. Profits available for dividends since organization amounted to $2,171,000,000. During the last decade such earnings have averaged $120,000,000 annually. Operating figures for 1925 are not yet available. However, in 1924, the corporation employed an average of 246,753 men, the aggregate payroll was $442,458,577, and the average daily wage per employee was $5.85.

**Westinghouse Electric & Manufacturing Company.**—All the motive machinery, controls and other electrical equipment for six electric passenger locomotives and two double-cab switching engines has been awarded to the Westinghouse Electric and Manufacturing Company by the Pennsylvania Railroad. The equipment will be shipped to the Altoona shops of the railroad, where the locomotives will be built.

**Wm. Wrigley, Jr. Company.**—The company has purchased a tract of land in London, England, for the construction of a plant costing between $500,000 and $1,000,000. This will make the third plant to be built outside of the United States, the others being in Germany and Australia.

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# Grinding and Agriculture

THE side-hill farm with its horse drawn plow and its man power has ceased to be of importance in the agricultural industry. Power machinery with its great capabilities now tills the soil.

In the production of agricultural implements the modern grinding wheel and precision grinding machine make possible comparatively low costs because of high and uniform production with accuracy.

The tractor rolling its way across the great grain fields; as well as the plows and harrows, the reapers and mowers that work with almost human skill, are machines that grinding makes perfect in operation. Practically every farming implement is now produced with the aid of the grinding wheel.

*This is but one of the great industries of the world that have made marked advances as a result of the discovery and development of electric furnace abrasives. The abrasive "Alundum" is now used in grinding and polishing in the metal working plants of the world. It is making floor materials slip-proof and safe to walk on. It is serving the chemist and power plant engineer in the form of laboratory ware and refractories.*

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Grinding Wheels-Refractories
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The Tie That Binds

*One of the Gerrard group of Wire Tying Machines—the Model "G" Little Giant for heavy packaging and Uni-Lastic Stowage. Ask us how to solve your packaging and shipping problems by this method.*

# Saving $28.93 per Hundred Cases

***The Test*** Two boxes, identical as to weight and content—one reenforced with nailed band iron and the other by the Gerrard Method of wire tying—were dropped from a 5' height onto a stone walk.

The box reenforced with band iron broke and spilled the contents. *The box reenforced* by the *Gerrard Method withstood* two tests, the contents remaining intact.

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***The Saving*** With the old method, 14 x 22 x 74 inch cases weighing 1082 pounds each were bound with ¾" 26 gauge band iron at a cost of $56.52 per 100 cases, including labor, material and overhead. The Gerrard Method of applying 9 gauge wire with the Model "G" Little Giant Machine increased the *strength* and *shock resistance* 100% for $27.59—a *saving of $28.93 per 100 cases.*

The manufacturer for whom the above tests were made is effecting a saving of about $4000.00 in the entire year's reenforcing costs.

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Have you received your copy of the new Gerrard illustrated catalog? It contains profit-earning information.

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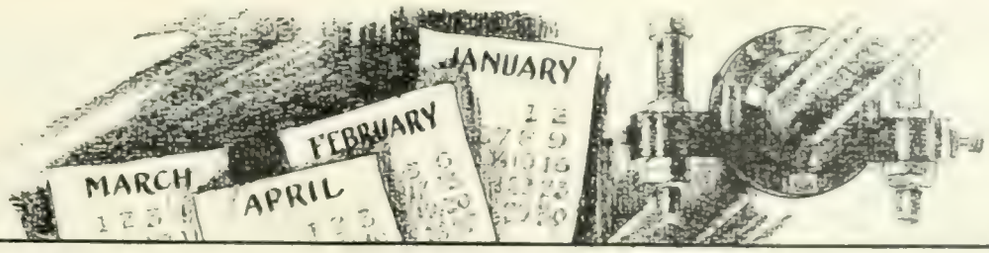


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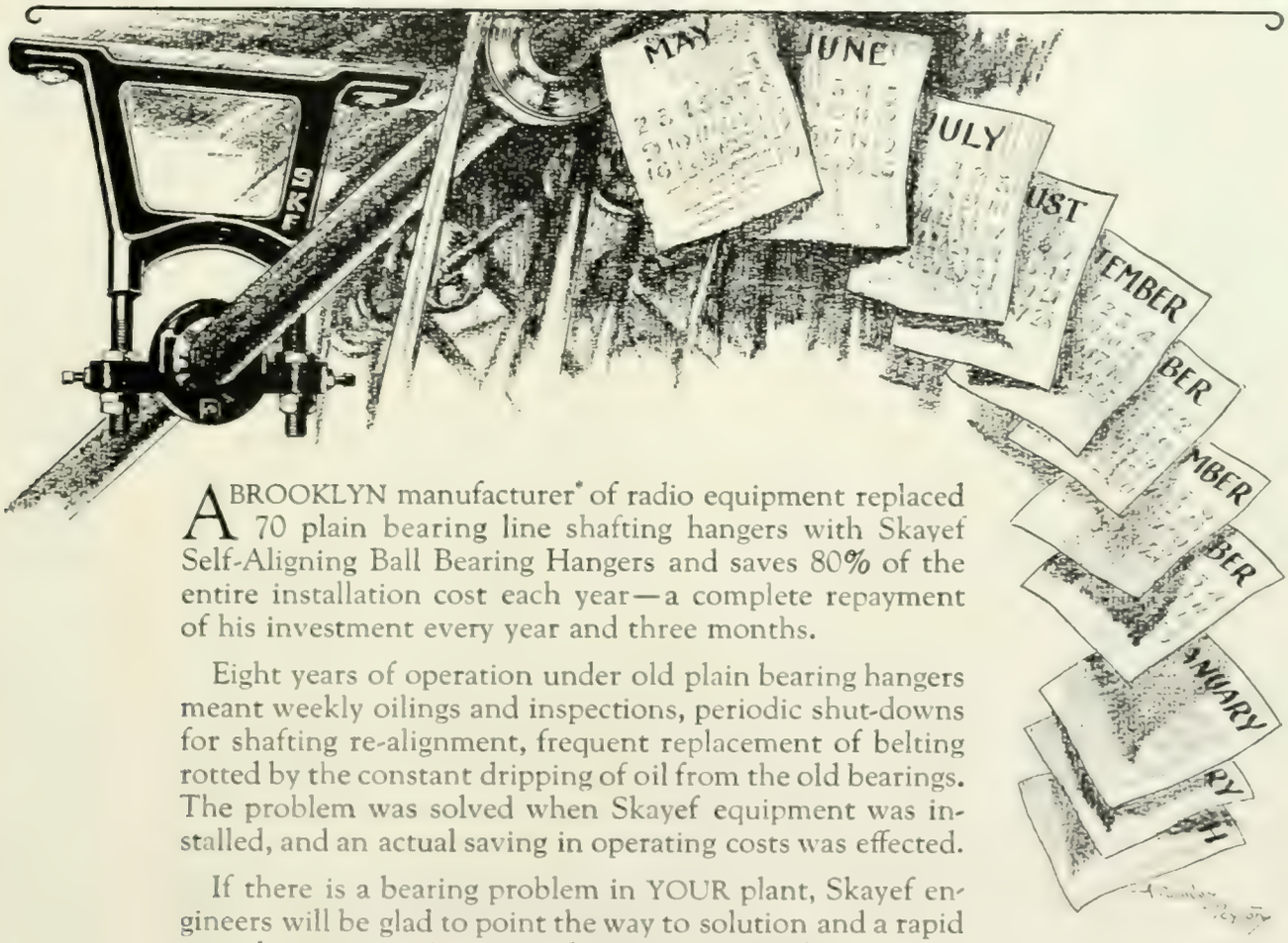


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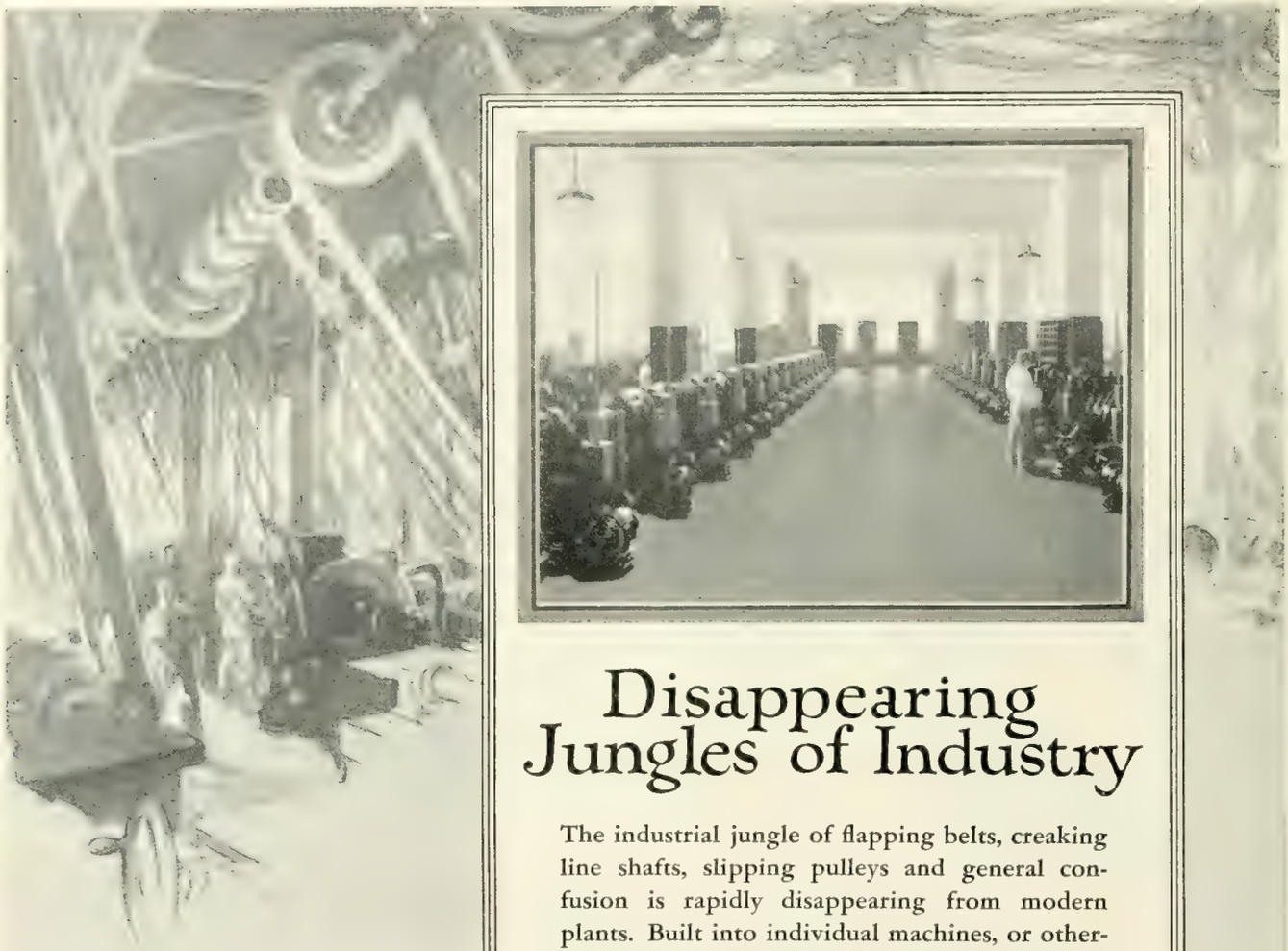



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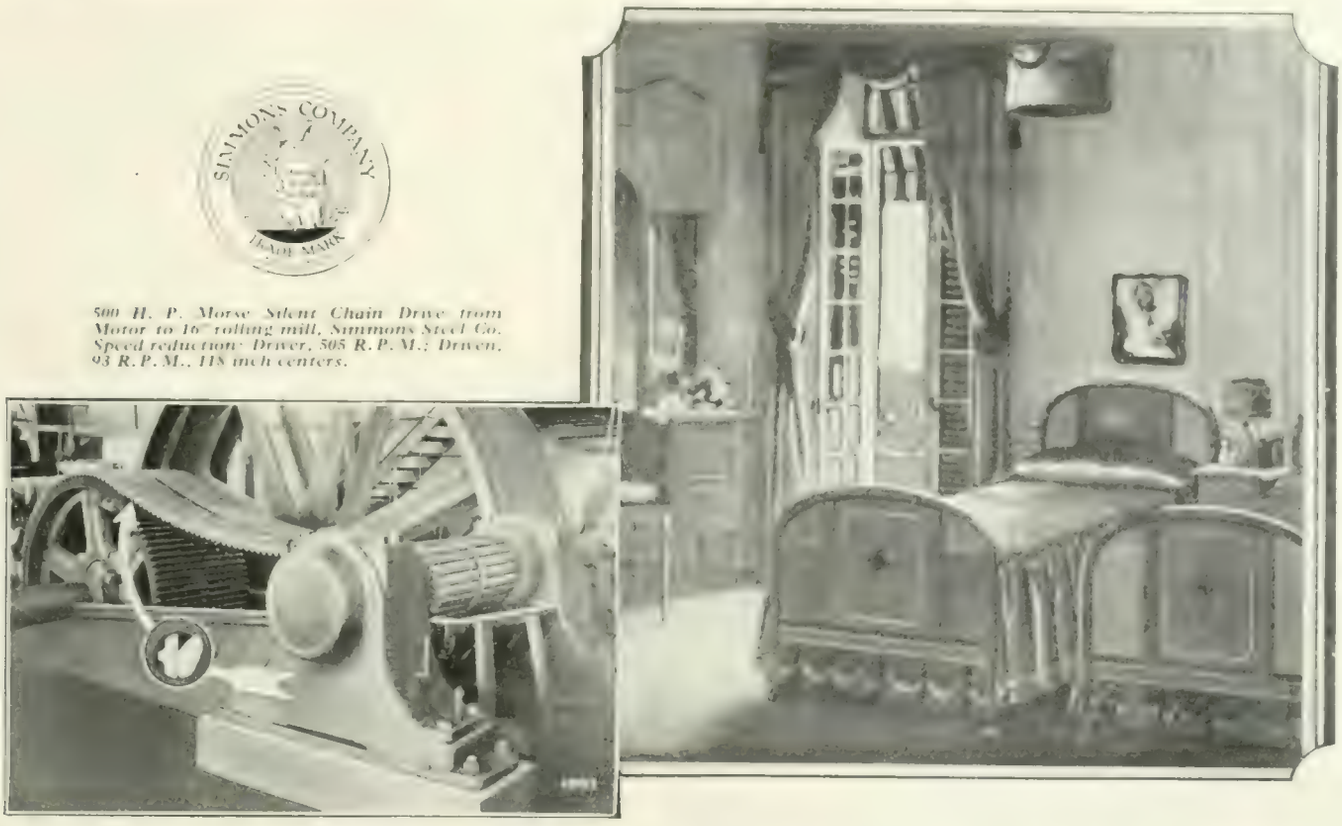

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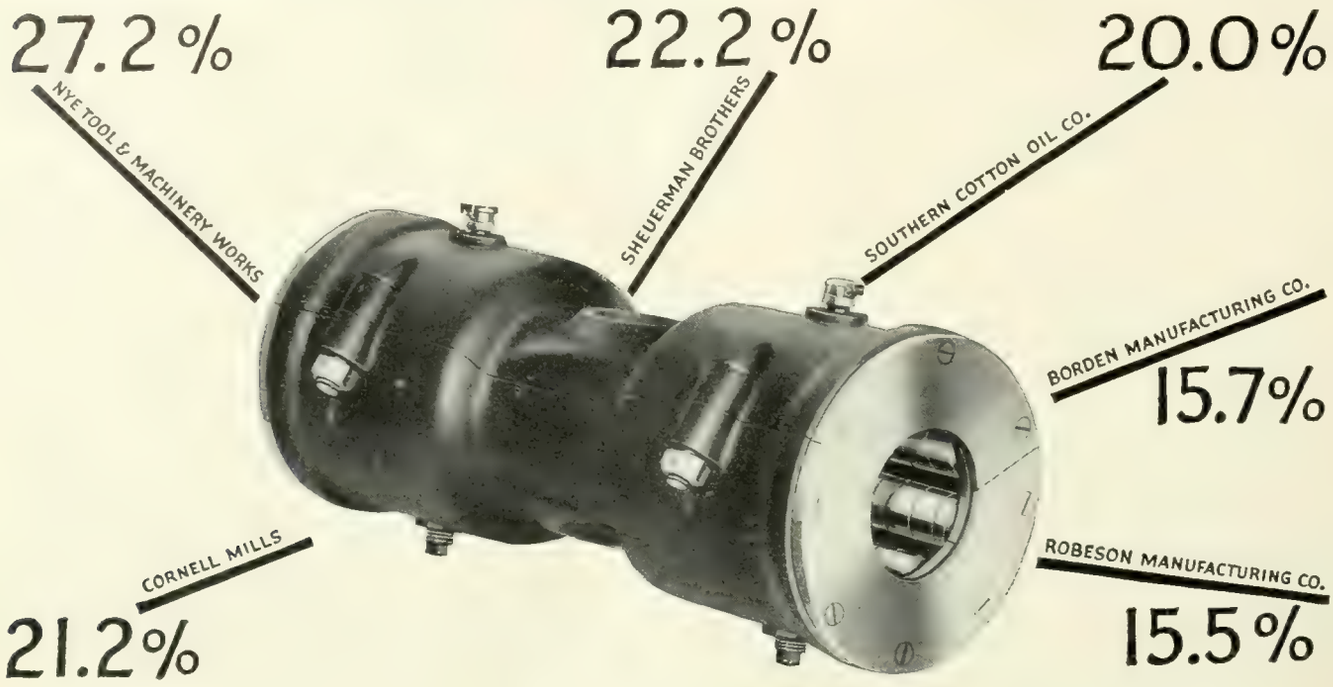


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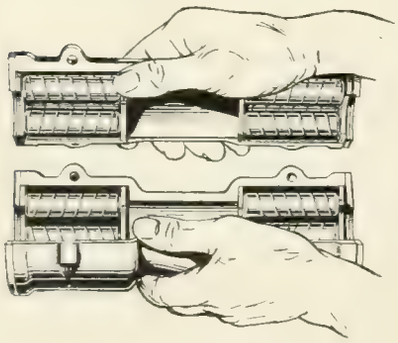

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L. P. Alford, *Editor* George E. Hagemann, *Associate Editor*

Vol. XI CONTENTS FOR MAY, 1926 No. 5


Bonus System Pays in Hoosier Plant . . . . . E. G. McQuinn 329
*General Manager, Brown Manufacturing Company*

Short Cuts to Accurate Order-Filling . . . . . John G. Aldrich 335
*Production and General Manager, New [illegible] Belt Company*

Labor-Saving Equipment Features New Westinghouse Air Brake Plant . . . . . G. W. Wildin 337
*Works Manager, Westinghouse Air Brake Company*

Major Results of Budgetary Control . . . . . W. S. Chthero 343
*Director of Budgets, Armour and Company*

Reducing Costs 22% by Motion Study . . . . . Jos. A. Piacitelli 347
*Engineer, Boston Automatic Company*

Visible Index for Stock Control . . . . . *Rice Motor Car Company* 350

Operating and Balance Sheet Ratios . . . . . Arthur Andersen 351
*Andersen Architects and Company*

The First Step in a Market Survey . . . . . H. L. Keely 355
*[illegible]-Merrell, Inc.*

Keeping Research on a Business Basis . . . . . George E. Hagemann 359
*Associate Editor, Manufacturing Industries*

Fatigue from a New Point of View . . . . . Howard W. Haggard 363
*Department of Applied Physiology, Scientific Section, National Safety Council*

Alignment Charts as Management Tools . . . . . F. J. Reuter 367
*Industrial Engineer*

Improved Methods Double Output . . . . . Charles F. O'Connor 369
*Production Manager, [illegible] Watch Company*

Computing Relative Speeds of Machines Without Time Study . Robert Mawson 371
*Industrial Engineer*

The Barth Standard Wage Scale . . . . . Charles D. Dennond and Carl G. Barth 373
*Consulting Engineers*

Guide to Latest Information . . . . . 375

News of Manufacturing Industries . . . . . 380


Rutledge Bermingham, *Advertising Manager* L. G. Henderson, *Circulation Manager*

Published monthly by THE RONALD PRESS COMPANY, Plum J. Wood, President and Treasurer, William J. Cooper, Secretary. Publication Office, [illegible] Ave., New York. Editorial and Executive Offices, 15 Park Row, New York. Notice of Change of Address must be received [illegible] days prior to the [illegible] of the month with which it is to take effect. Copies cannot be supplied to replace [illegible] received after [illegible] days from date of publication. Remittances should be made payable to The Ronald Press Company. Price [illegible] a year; foreign [illegible] a year; single copies, [illegible] cents each.

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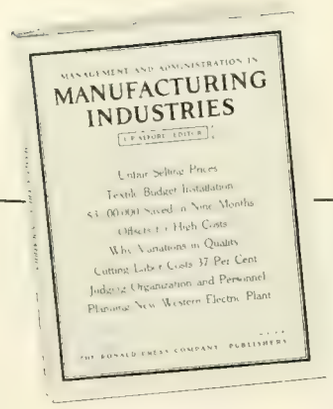
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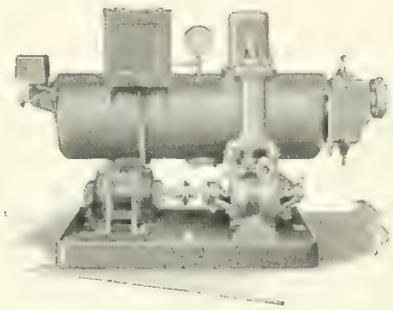

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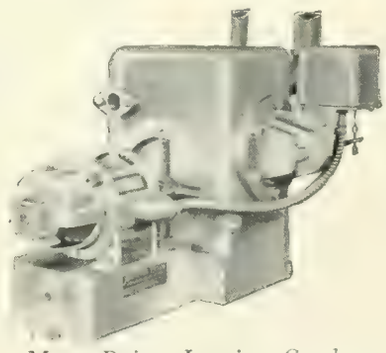

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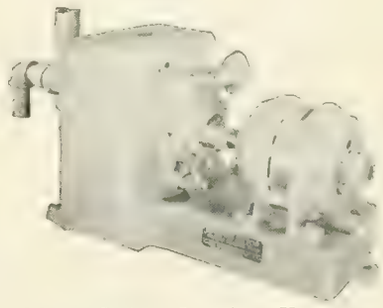

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# MANUFACTURING INDUSTRIES

VOLUME XI MAY, 1926 NUMBER 5

# Bonus System Pays in Hoosier Plant

## Reduces Waste and Adds to Output Where Methods Already Were Modern

By E. G. McQUINN

*General Manager, The Hoosier Manufacturing Company*

SOME 25 years ago, the Hoosier Manufacturing Company was started with 25 men in the vacated Speeder Bicycle Company's plant at New Castle, Indiana. Kitchen cabinets and fan mills were the products manufactured.

Because of the high manufacturing costs resulting from this dissimilarity of products, it was decided after several years to throw all resources into the manufacture of kitchen cabinets in order to place a superior product within the reach of every housewife. That this policy met with success is evidenced by the fact that in 1913 our working force had been increased to 600 men.

Recognizing the merit of satisfied and well paid employees, we decided in 1917 to install wage incentives throughout the factory. Accordingly, we retained the services of consultants to do this work, but after a year and a half at our plant, we were forced to discontinue their services because the methods used were unsuited to the conditions and caused a natural dissatisfaction in our organization.

By 1923, our own factory staff had made rapid strides in the development of manufacturing methods to cope with our ever increasing sales volume. Our anual soft and hard wood lumber requirements were over 9,000,000 ft. This lumber was stored and moved to the kilns on trucks and special machines or fixtures were being used for each important operation. A method of mechanical handling was installed whereby the product moved continuously on belt conveyors from its partial assembly through all subsequent assembly, finishing, trimming and packing operations to the warehouse, or direct to the freight car. No effort was spared to keep our factory processes and equipment in the forefront of successful modern developments. These facilities enabled us to manufacture as high as 3000 kitchen cabinets per week without any overtime.

Up to 1923, we had enjoyed each year a volume production of a practically standardized product. But market conditions were changing, with the result that we were soon manufacturing kitchen units and kitchen tables in connection with a greater variety of kitchen cabinets. This variety naturally resulted in increased manufacturing costs, which, together with the competition of a higher wage scale from a local automobile plant, aroused a more intense interest in the benefits to be derived from the installation of the proper industrial methods, particularly in our mill room.

While our previous experience with outside industrial counsel had been disappointing, our own factory organization was already too busy with its own work to devote any time to making extensive modifications

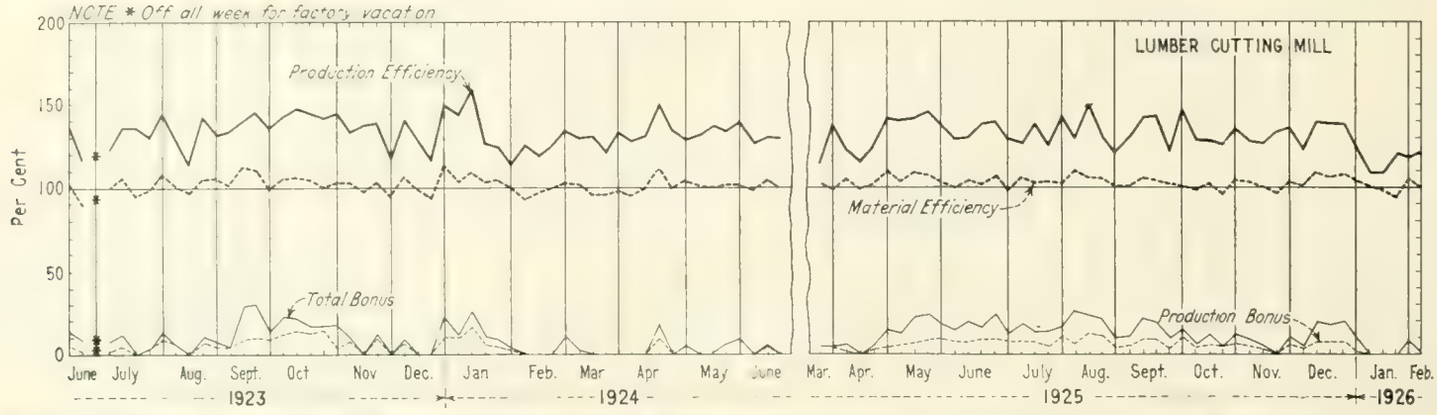



FIG. 1 LUMBER CUTTING MILL WEEKLY PRODUCTION AND MATERIAL EFFICIENCIES AND BONUS PAID UNDER INCENTIVE PLAN

Previous average efficiency of production and of material use=100 per cent line. Material bonus paid is the difference between total bonus and production bonus on the chart. Period from July 1, 1924 to March 24, 1925 omitted to save space.

in industrial methods. Accordingly, we engaged Bigelow, Kent, Willard and Company,[1] consulting engineers and accountants, to reduce the material and labor costs in our mill room, and at the same time to reward our employees with higher wages. The results they obtained in this department amply justified our confidence in the industrial methods pursued. We therefore authorized them to continue their work throughout the factory, and the installation of the new methods extended, in all, over two years.

*Lumber Cutting Mill.* In this department a careful study was made of planing, cutting off, jointing, gluing up, supplying, and waste sorting operations. The foremen and workmen were instructed in material- and labor-saving methods and improvements were made to help bring results about. Clerical work in this department was also simplified prior to the bonus installation.

We use a combined waste and production bonus plan for this department as a group. Bonus earnings are determined from the final net material waste and net production efficiency of the group each week, and are included in the workmen's pay on the next pay day.

The inspector for this department also has charge of the disposition of all culls and lumber waste returned from the other departments. He sends this material to the department which can salvage it most economically.

The performance of this department, after the installation of bonus, is shown in Fig. 1. The increases for the full period, from June 19, 1923 to February 9, 1926, average: Production efficiency 30.6 per cent; material efficiency 2.3 per cent; total bonus, or increase in weekly pay of the workmen, 8.6 per cent.

*Machine and Door Department.* This group is made up of three separate sub-departments:

Back machine room, or sticker room
Front machine room
Door room

These comprise a crew of about 80 men and three foremen, all of whom participate weekly in the same combined waste and production bonus plan, based on the final net material and net production efficiency of the group as a whole.

The benefits of combining these three departments in one bonus group are as follows:

1. Close co-operation between all departments.
2. Willingness of the workmen to be transferred from one department to another in order to maintain a balanced or paired-up production.
3. A very high turn-over of work-in-process resulting in a very small inventory of unfinished production at the end of each bonus week.

[1] Acknowledgment is made to Alfred F. Kenrick, of Bigelow, Kent, Willard and Company, for assistance in preparing data for this article.

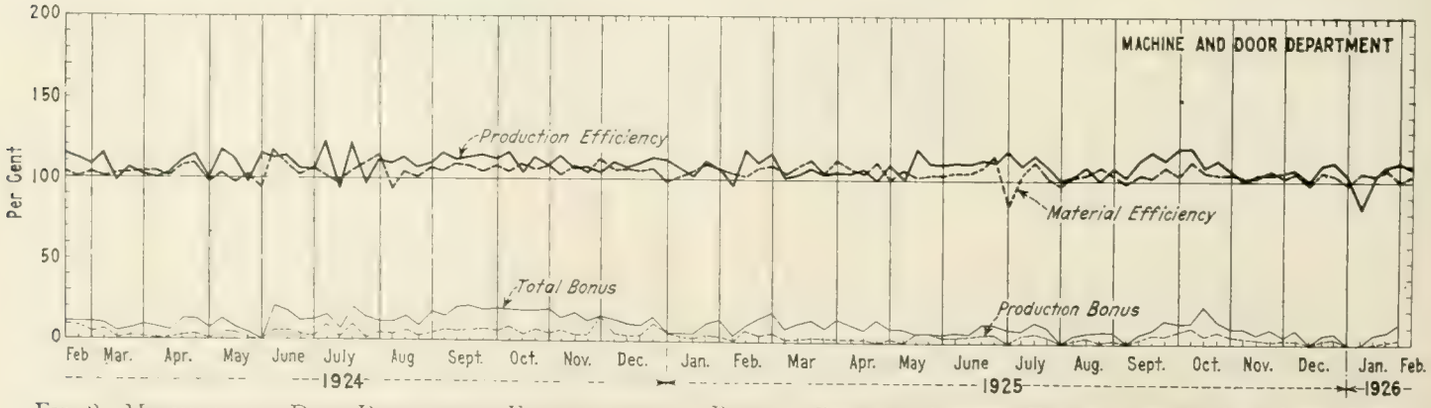



FIG. 2 MACHINE AND DOOR DEPARTMENT EFFICIENCIES AND BONUS. PREVIOUS AVERAGE EFFICIENCY=100 PER CENT LINE

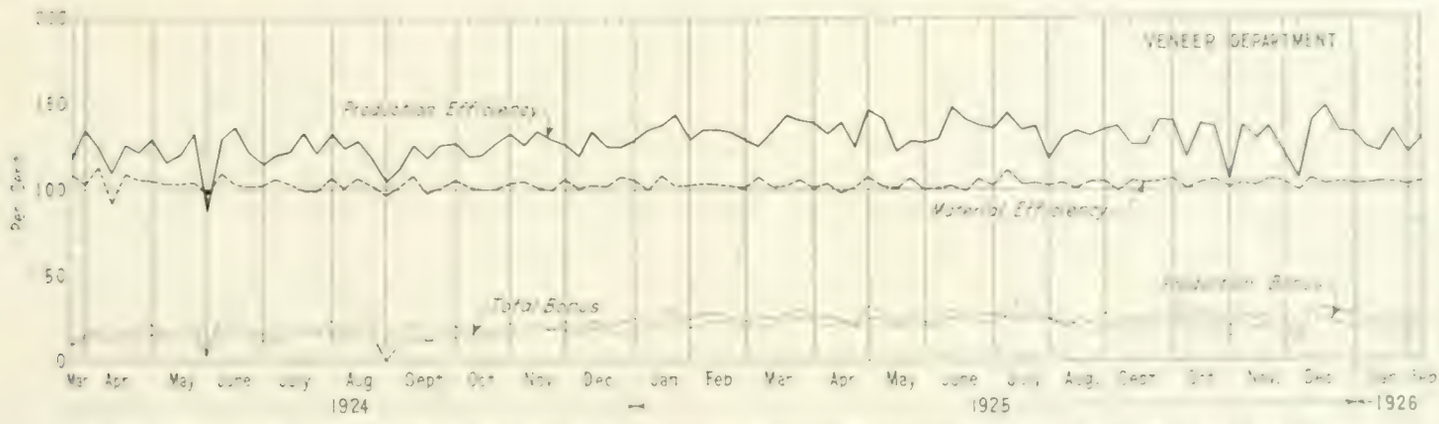



FIG. 3 VENEER DEPARTMENT EFFICIENCIES AND BONUS. PREVIOUS WEEKLY EARNINGS [illegible]

The increased earnings and efficiency ratings of this group after the bonus installation are shown in Fig. 2. They average for the period charted: Production efficiency 7.9 per cent; material efficiency 3.2 per cent; total bonus 10 per cent.

*Veneer Department.* The same method was used in this department as outlined for the mill room, that is, a careful study of existing methods and instruction

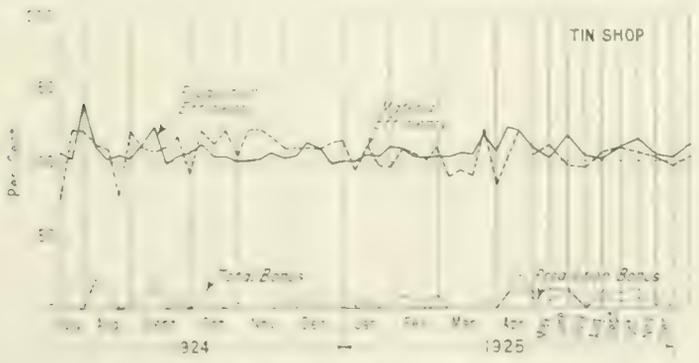



FIG. 4 TIN SHOP EFFICIENCIES AND BONUS

of the foremen and workmen in material and labor saving methods before the bonus installation. A combined waste and production bonus plan, similar to the mill room, is used for this department as one group. Bonus earnings are determined weekly from the final net material waste and net production efficiency of the group, and are included in the workmen's pay on the following pay day. The inspector in the mill room handles all charges for culled veneer returned through him from the various departments.

The outstanding advantages of this group plan of wage incentives as applied to this department are:

1. Close co-operation to maintain a quality production as the bonus for the group is dependent upon this factor.
2. Ease and willingness of the workmen to be transferred from one operation to another in order to maintain a balanced production, and without the need of any clerical work.
3. A very high turnover of work in-process resulting in a very small inventory of unfinished production at the end of each bonus week.

The increased earnings of this group after the bonus installation, together with the efficiency ratings, are shown in Fig. 3. For the period charted these increases average: Production efficiency 28.2 per cent; material efficiency 4.2 per cent; total bonus 22.7 per cent.

*Tin Shop.* While the Tin Shop is regarded as one department, it consists of punch presses, a semi-finished stock room, and assembly, with a personnel of 30 workmen and two foremen. In spite of the semi-finished stock room between the major manufacturing operations, we use a combined waste and production bonus plan for the whole department as one group. As in the bonus groups described above, the bonus earnings are determined weekly from the final net material and net production efficiency of the group.

Bonus earnings and efficiency ratings for this group are shown in Fig. 4. Increases for the period charted average: Production efficiency 7.1 per cent; material efficiency 5.9 per cent; total bonus 4.8 per cent.

*Finishing Department.* Our present factory layout is such that the Finishing Department is located on different floors of several buildings. A general foreman is in charge, assisted by sub-foremen in the specialized finishing departments. For bonus purposes, however, these finishing departments were subdivided

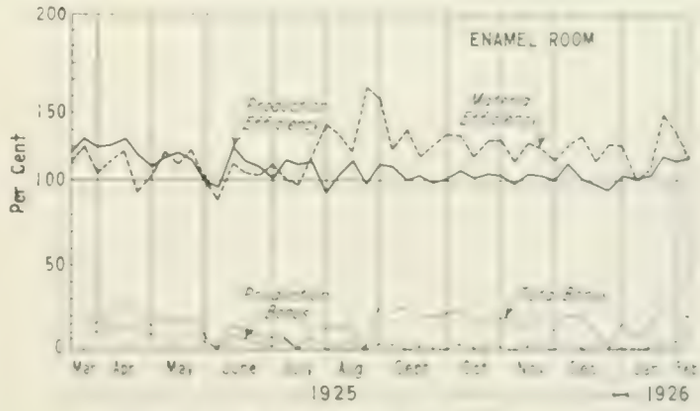



FIG. 5 [illegible]

into five distinct groups but without any physical rearrangement of departments. These groups are: Enamel Room; Brown Finishing; Cabinet Units, Chairs, and Stools; Tin Finishing; and Gray Coat. They will be explained in the order named.

TABLE 1. BROWN FINISHING DEPARTMENT EFFICIENCIES AND BONUS

| Week Ending | Efficiencies—Per Cent | | Bonus Paid—Per Cent | | |
|---|---|---|---|---|---|
| | Production | Material | Production | Material | Total |
| Mar. 24, 1925 | 91.4 | | | | |
| " 31 | 91.0 | 102.9 | | | |
| Apr. 7 | 101.4 | 106.8 | 1.0 | 1.0 | 2.0 |
| " 14 | 98.4 | 107.4 | | 10.0 | 10.0 |
| " 21 | 117.2 | 118.7 | 9.5 | 7.0 | 16.5 |
| " 28 | 122.3 | 104.5 | 13.0 | 4.0 | 17.0 |
| May 5 | 102.2 | 103.9 | 4.5 | 3.0 | 7.5 |
| " 12 | 86.4 | 116.9 | .. | 5.5 | 5.5 |
| " 19 | 88.9 | 123.0 | | | |
| " 26 | 103.2 | 113.8 | 2.5 | 6.0 | 8.5 |
| June 2 | 112.0 | 113.1 | 5.5 | 6.0 | 11.5 |
| " 9 | 91.3 | 102.6 | | | |
| " 16 | 114.9 | 115.5 | 4.0 | 6.5 | 10.5 |
| " 23 | 108.9 | 119.9 | 3.0 | 8.5 | 11.5 |
| " 30 | 99.6 | 102.8 | | 6.0 | 6.0 |
| July 7 | 99.6 | 107.1 | | | |
| " 14 | 124.2 | 113.1 | 9.0 | 6.0 | 15.0 |
| " 21 | 102.3 | 117.2 | 2.0 | 7.0 | 9.0 |
| " 28 | 97.2 | 137.1 | | 12.0 | 12.0 |
| Aug. 4 | 117.0 | 138.7 | 7.5 | 12.5 | 20.0 |
| " 11 | No golden oak cabinets in production | | | | |
| " 18 | " " " " | | | | |
| " 25 | " " " " | | | | |
| Sept. 1 | " " " " | | | | |
| " 8 | " " " " | | | | |
| " 15 | 66.6 | 98.4 | | | |
| " 22 | 74.4 | 112.3 | | | |
| " 29 | 97.7 | 142.2 | | | |
| Oct. 6 | 96.6 | 119.7 | | .. | |
| " 13 | 96.7 | 146.4 | | | |
| " 20 | 94.9 | 131.2 | | | |
| " 27 | 89.0 | 115.3 | | .. | |
| Nov. 3 | 74.5 | 130.7 | | | |
| " 10 | 87.0 | 137.9 | | | |
| " 17 | 102.7 | 136.8 | | | |
| " 24 | 92.6 | 139.5 | | | |
| Dec. 1 | 90.6 | 120.2 | | | |
| " 8 | 102.1 | 136.3 | 3.0 | 16.0 | 19.0 |
| " 15 | 102.6 | 132.1 | 2.5 | 16.0 | 18.5 |
| " 22 | 111.5 | 133.6 | 6.5 | 16.5 | 23.0 |
| " 29 | 97.2 | 125.9 | 2.0 | 14.5 | 16.5 |
| Jan. 5, 1926 | Not in Bonus | | | | |
| " 12 | " " " | | | | |
| " 19 | " " " | | | | |
| " 26 | " " " | | | | |
| Feb. 2 | 100.0 | 93.7 | | | |
| " 9 | 114.1 | 111.5 | 5.0 | 5.5 | 10.5 |

[1] Based on standard production efficiency and material efficiency previous to bonus plan = 100 per cent.

In the determination of this bonus, we do not compute our bonus earnings on the final net material waste and net production efficiency from the group performance itself, but from the ultimate finished and inspected factory production available for shipment. This basis of computation automatically forces each group to balance its own production in accordance with the finished production available for customer use and hence makes for balanced conditions in the factory without any danger from overproduction of parts.

*Enamel Room.* We use a combined waste and production bonus plan for this group. Bonus earnings are determined from the final net material waste and net production efficiency in terms of final inspected factory production. The bonus earnings included in the workmen's pay on the following pay day, together with the efficiency ratings, are shown for a period of time in Fig. 5. The increases average for the period charted: Production efficiency 7.4 per cent; material efficiency 16.6 per cent; total bonus 14.9 per cent.

*Brown Finishing.* Although some of the operations in this department were on a piece-work plan, we found it possible to incorporate this method of wage payment in our combined waste and production plan. Bonus earnings are determined from the final net material waste and net production efficiency in terms of the final inspected factory production and such earnings are included in the workmen's envelope on the following pay day.

The sub-foreman (of the men working on the old piece work plan), however, participates in the group bonus plan on the basis of the production efficiency of the piece-workers plus a participation in the material savings. Bonus earnings and efficiency ratings for this group over a period of time are shown in Table 1. For the period included in the table these averaged: Production efficiency decreased one per cent; material efficiency increased 16.6 per cent; total bonus increased 6.6 per cent.

*Cabinet Units, Chairs and Stools.* The combined waste and production bonus plan, in effect for all the

TABLE 2. CABINET UNITS, CHAIRS AND STOOLS

| Week Ending | Efficiencies—Per Cent[1] | | Bonus Paid—Per Cent | | |
|---|---|---|---|---|---|
| | Production | Material | Production | Material | Total |
| Mar. 24, 1925 | 84.8 | 104.2 | | | |
| " 31 | 115.3 | 108.4 | 5.0 | 3.0 | 8.0 |
| April 7 | 120.9 | 122.8 | 10.5 | 10.5 | 21.0 |
| " 14 | 136.7 | 163.7 | 17.5 | 7.5 | 25.0 |
| " 21 | 102.1 | 97.5 | 7.0 | 5.5 | 12.5 |
| " 28 | 108.6 | 94.2 | 7.5 | 3.5 | 11.0 |
| May 5 | 130.3 | 223.2 | 17.0 | 21.0 | 38.0 |
| " 12 | 105.2 | 106.8 | 7.0 | 8.5 | 15.5 |
| " 19 | 78.8 | 103.2 | | .... | |
| " 26 | 69.7 | 54.8 | | | |
| June 2 | 106.0 | 105.8 | 1.5 | 1.5 | 3.5 |
| " 9 | 109.8 | 98.8 | | .... | |
| " 16 | 126.8 | 101.2 | 8.5 | 1.5 | 10.0 |
| " 23 | 132.5 | 85.2 | | | |
| " 30 | 123.9 | 96.6 | | | |
| July 7 | Not in Bonus this week | | | | |
| " 14 | " " " | | | | |
| " 21 | 106.8 | 75.3 | | | |
| " 28 | 84.6 | 65.8 | | | |
| Aug. 4 | 67.8 | 70.2 | | | |
| " 11 | 126.1 | 138.6 | 13.0 | 1.0 | 14.0 |
| " 18 | 53.3 | 84.0 | | | |
| " 25 | 58.3 | 73.7 | | | |
| Sept. 1 | 71.0 | 53.9 | | | |
| " 8 | 75.8 | 55.5 | | | |
| " 15 | 89.9 | 58.3 | | | |
| " 22 | 85.8 | 48.6 | | | |
| " 29 | 104.1 | 78.3 | | | |
| Oct. 6 | 104.4 | 57.2 | | | |
| " 13 | 105.1 | 117.4 | 2.5 | 10.5 | 13.0 |
| " 20 | 119.7 | 128.9 | 7.5 | 17.0 | 24.5 |
| " 27 | 114.1 | 116.0 | 5.5 | 11.5 | 17.0 |
| Nov. 3 | 102.5 | 129.1 | 4.5 | 18.0 | 22.5 |
| " 10 | 94.8 | 109.5 | 1.5 | 11.5 | 13.0 |
| " 17 | 100.1 | 125.9 | 2.5 | 17.0 | 19.5 |
| " 24 | 85.6 | 110.0 | | | |
| Dec. 1 | 32.3 | 48.0 | | | |
| " 8 | 50.5 | 85.7 | | | |
| " 15 | 68.2 | 124.2 | | | |
| " 22 | 82.8 | 119.2 | | | |
| " 29 | 73.2 | 123.5 | | | |
| Jan. 5, 1926 | 111.4 | 129.6 | | | |
| " 12 | 61.0 | 126.0 | | | |
| " 19 | 85.3 | | | | |
| " 26 | 119.5 | 79.3 | | 8.0 | 8.0 |
| Feb. 2 | 132.2 | 184.6 | 12.5 | 7.5 | 20.0 |
| " 9 | 108.3 | 99.0 | 2.0 | 10.0 | 12.0 |

[1] Based on standard production efficiency and material efficiency previous to bonus plan = 100 per cent.

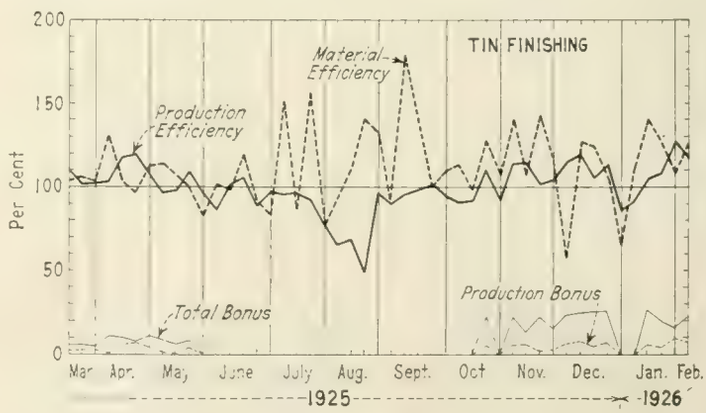
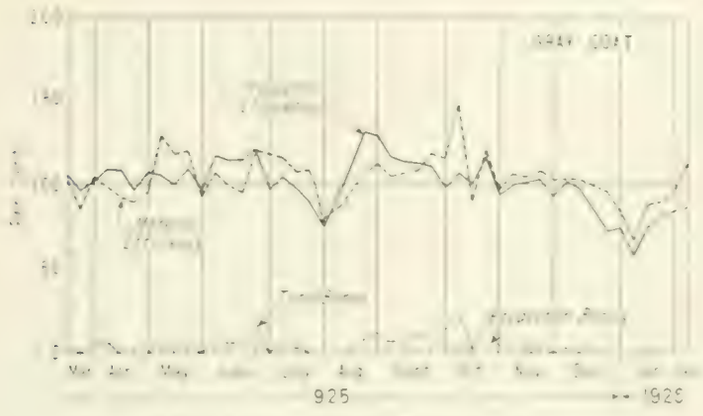



FIG. 6 TIN FINISHING DEPARTMENT




other finishing groups, is used in this group, together with the bonus earnings determined from the final net material and net production efficiency in terms of the final inspected factory production. Bonus earnings are included in the workmen's pay on the following pay day, and the range of bonus earnings and efficiency ratings over a period of time are shown in Table 2. The period covered by the table shows averages

TABLE 3. TOP CASE PRESSES DEPARTMENT

| Week Ending | Efficiency | Bonus Paid Per Cent | Week Ending | Production | Bonus Per Cent |
|---|---|---|---|---|---|
| April 11 | 105.6 | 3.5 | Sept. 27 | 97.8 | |
| " 17 | 100.7 | 3.0 | " 22 | 107.7 | 2.0 |
| " 24 | | 3.0 | " 29 | 100.0 | |
| May 3 | 105.7 | | Oct. 6 | 101.7 | |
| " 10 | | 4.0 | " 13 | 100.9 | |
| " 17 | 106.7 | 4.0 | " 20 | 102.0 | 1.0 |
| " 24 | 107.7 | 4.5 | " 27 | 103.1 | 1.5 |
| June 2 | 99.2 | 1.5 | Nov. 3 | 98.2 | |
| " 9 | 98.8 | 1.5 | " 10 | 96.2 | |
| " 16 | 105.5 | 4.0 | " 17 | 97.6 | |
| " 23 | 104.8 | 4.0 | " 24 | 99.0 | |
| " 30 | 111.8 | 5.5 | Dec. 1 | 98.8 | |
| July 7 | 102.2 | 2.5 | " 8 | 128.8 | 21.5 |
| " 14 | 102.3 | 2.0 | " 15 | 126.4 | 20.5 |
| " 21 | 108.6 | 5.0 | " 22 | 125.0 | 19.5 |
| " 28 | 109.0 | 5.5 | " 29 | 115.6 | 12.0 |
| Aug. 4 | 99.7 | 2.0 | Jan. 5, 1926 | 121.9 | 16.0 |
| " 11 | 98.2 | | " 12 | 119.6 | 15.5 |
| " 18 | 101.1 | | " 19 | 120.7 | 16.0 |
| " 25 | 103.3 | 3.0 | " 26 | 129.3 | 17.0 |
| Sept. 1 | 97.4 | | Feb. 2 | 124.6 | 17.0 |
| " 8 | 97.1 | | " 9 | 114.8 | 13.5 |

as follows: Production efficiency decreased 5 per cent; material efficiency unchanged; total bonus increased 6.8 per cent.

*Tin Finishing.* This group finishes the tinware for our products. The bonus earnings for this group are determined from the final net material waste and net production efficiency in terms of the final inspected factory production of all finishes that use tinware. The increased earnings for the workmen, as a result of the installation of this combined waste and production bonus, together with the efficiency ratings, are shown in Fig. 6. Increases for the period covered by the chart average: Production efficiency unchanged; material efficiency 13.7 per cent; total bonus 8.1 per cent.

*Gray Coat.* While this department finishes the various products with different undercoats and enamels, it operates under a combined waste and production bonus plan for the whole department as one group. The bonus earnings in this group, like those of the other finishing groups, are determined from the final net material and net production efficiency in terms of the final inspected factory production. Bonus earnings and efficiency ratings for this group are shown in Fig. 7. The period charted shows averages as follows: Production efficiency unchanged; material efficiency unchanged; total bonus 5.3 per cent.

*Top Case Presses.* As this department deals with the assembly of finished parts, the opportunity for material saving was so negligible that we operate it under a group production plan only. However, the production bonus plan is designed to compensate the workmen for the lack of the material bonus factor. The bonus earnings for this group are determined from the final net production efficiency in terms of the final inspected factory production.

There is a sub-foreman over this group who participates in the same bonus earnings as the men. The general foreman, however, only receives a part of the bonus earnings, since he also participates in the earnings of the other bonus groups under his charge. Bonus earnings and efficiency ratings for this group are shown in Table 3. Average increases for the period covered are: Production efficiency 6.8 per cent; bonus 5.3 per cent.

*Cabinet Bases.* Part of this department was already operating under the old piece-work plan. In view of this, the plan was extended to the whole department. Because of improved conditions the department was already maintaining an efficiency well above old rates of production. Consequently 145 per cent of these old rates was set as the standard at which bonus should start.

The general and sub-foreman participate in the department piece-work earnings on the basis of the efficiency of the workers' earnings. Earnings and efficiency ratings of the group under this plan are shown in Table 4. The period included in the table shows an average increase in production efficiency of 61 per cent on the old basis (or 11.1 per cent on the 145 per cent basis), and an increase in pay of 11.8 per cent.

*Top Case Door Hangers.* Like the Cabinet Base

TABLE 4 CABINET BASES DEPARTMENT

| Week Ending | Efficiency | Bonus Paid Per | Week Ending | | |
|---|---|---|---|---|---|
| April 11 | 143.8 | | Sept. 15, 1925 | 160.4 | |
| " 17 | 147.3 | | " 22 | 164.2 | |
| " 24 | 151.3 | 5.0 | " 29 | 165.6 | 16.0 |
| May 1 | 154.1 | 7.5 | Oct. 6 | 174.4 | 18.5 |
| " 8 | 149.2 | 3.5 | " 13 | 164.5 | 8.5 |
| " 15 | 146.8 | 1 | " 20 | 162 | |
| " 22 | 152.6 | 4.5 | " 27 | 160 | 16.5 |
| June 5 | 159.1 | 7.5 | Nov. 3 | 169.5 | 18.0 |
| " 12 | 158.7 | | " 10 | 169.6 | 18.5 |
| " 19 | 157.1 | | " 17 | | 17.0 |
| " 26 | 160.3 | | " 24 | | 16.5 |
| July 3 | 162.3 | 11 | Dec. 1 | 171 | 14.5 |
| " 10 | 155.7 | | " 8 | 162.5 | |
| " 17 | 159.8 | 11.0 | " 15 | 164.5 | |
| " 24 | 157.3 | | " 22 | 160.1 | 13.5 |
| " 31 | 161.2 | 11 | " 29 | 166.4 | 11.5 |
| Aug. 7 | 160.4 | 11.5 | Jan. 5, 1926 | 166.2 | |
| " 14 | 162.7 | 13 | " 12 | 168.4 | 8 |
| " 21 | 162.3 | 12 | " 19 | 153.4 | 9.0 |
| " 28 | 171.9 | | " 26 | 154.6 | 8.5 |
| Sept. 4 | 167.3 | 15.5 | Feb. 2 | 173.7 | 15.5 |
| " 11 | 167.7 | | " 9 | 178.1 | 18.0 |

Department, this group was operating under an old piece-work plan, which was brought up to date to include the wider variety of manufactured products. Improved conditions already in effect enabled a standard of 175 per cent of old production ratios to be used as the starting point of bonus. The general and subforemen participate in the department piece-work earnings on the basis of the efficiency of the workers' earnings. Increased workers' earnings and efficiency ratings are shown in Table 5. They average for the period covered: Production efficiency 90 per cent on the old basis (or 8.5 per cent on the 175 per cent basis); bonus 11.4 per cent.

*Trimming Department.* As this department affords no opportunity for material saving, we operate it under a group production bonus plan only, compensating the workmen, however, by a better bonus reward to offset the lack of the material bonus factor. Bonus earnings are based on the final net production efficiency in terms of final inspected factory production and efficiency ratings. The incentive system was put into effect the week ending January 19, 1926. For the period of the next four weeks the average increases were as follows: Production efficiency 19 per cent; bonus 11.5 per cent.

TABLE 5. TOP CASE DOOR HANGERS DEPARTMENT

| Week Ending | Production Efficiency | Bonus Paid Per Cent | Week Ending | Production Efficiency | Bonus Paid Per Cent |
|---|---|---|---|---|---|
| April 14, 1925 | 174.5 | | Sept. 15, 1925 | 192.3 | 11.0 |
| " 21 | 183.0 | 6.5 | " 22 | 202.3 | 15.5 |
| " 28 | 185.2 | 8.0 | " 29 | 197.8 | 15.0 |
| May 5 | 178.7 | 3.0 | Oct. 6 | 195.1 | 15.0 |
| " 12 | 168.5 | | " 13 | 185.7 | 12.0 |
| " 19 | 174.5 | 0.5 | " 20 | 195.9 | 15.5 |
| " 26 | 214.8 | 16.5 | " 27 | 199.4 | 17.0 |
| June 2 | 173.0 | 2.5 | Nov. 3 | 201.1 | 18.5 |
| " 9 | 169.5 | 0.5 | " 10 | 198.1 | 17.0 |
| " 16 | 191.9 | 6.5 | " 17 | 191.9 | 14.5 |
| " 23 | 182.2 | 5.5 | " 24 | 196.6 | 16.5 |
| " 30 | 190.1 | 9.5 | Dec. 1 | 192.1 | 15.5 |
| July 7 | 189.2 | 10.0 | " 8 | 203.1 | 19.5 |
| " 14 | 187.8 | 8.0 | " 15 | 196.0 | 16.5 |
| " 21 | 180.9 | 6.0 | " 22 | 187.8 | 13.5 |
| " 28 | 185.5 | 9.0 | " 29 | 189.3 | 13.5 |
| Aug. 4 | 184.3 | 7.5 | Jan. 5, 1926 | 191.8 | 14.0 |
| " 11 | 187.0 | 9.0 | " 12 | 176.7 | 7.5 |
| " 18 | 180.2 | 6.0 | " 19 | 202.3 | 16.5 |
| " 25 | 188.4 | 9.0 | " 26 | 207.0 | 18.5 |
| Sept. 1 | 185.2 | 7.5 | Feb. 2 | 205.4 | 18.5 |
| " 8 | 192.2 | 10.5 | " 9 | 215.6 | 23.5 |

[1] Based on standard production efficiency previous to bonus plan = 175 per cent.

*Table Finishing Department.* The results accomplished are given in Fig. 8. The increases for the period charted are: Production efficiency 9.6 per cent; material efficiency 21.4 per cent; total bonus 19.1 per cent.

## Benefits of the Installation

*Summary.* Since the installation of group bonus in the departments outlined above, we have broadened our range of products to include the manufacture of kitchen stools, chairs, servers, and buffets, as well as new styles of two-tone kitchen cabinets and kitchen tables. In spite of this, our own organization has been able to extend the group bonus plans to include these newer products, with the result that the bonus is operating as satisfactorily now as when originally designed.

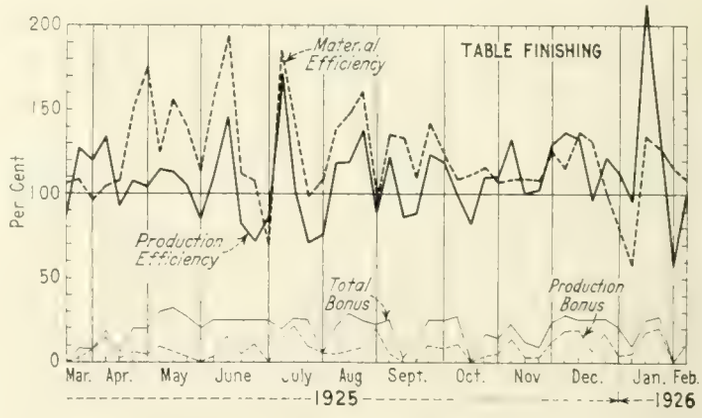



FIG. 8 TABLE FINISHING DEPARTMENT

We find that our cost methods have been greatly simplified since the installation of group bonus and in reality we are obtaining more accurate, uniform and dependable costs than heretofore, in spite of the larger variety of products involved. There has been practically no increase in clerical help to maintain the bonus installations.

Since monetary savings to us have been far in excess of the cost of the bonus installation, as well as paying the workmen and foremen much appreciated increases, we are thoroughly convinced that the new methods are fundamentally sound, and that the results accomplished will be of permanent benefit throughout our entire organization.

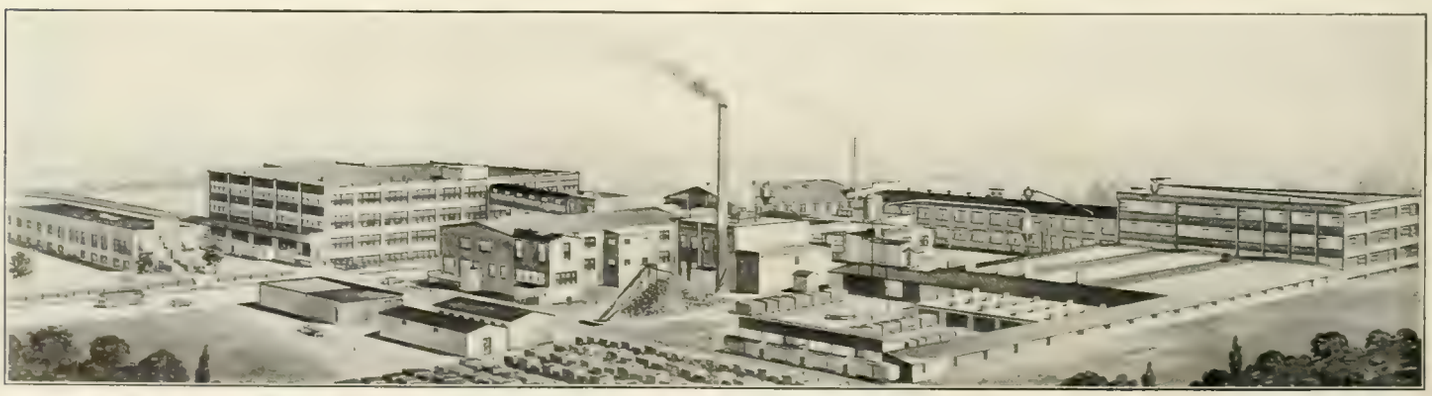


FIG. 9 PLANT OF THE HOOSIER MANUFACTURING COMPANY, KITCHEN CABINET MAKERS, NEW CASTLE, INDIANA

# Short Cuts to Accurate Order-Filling

## Methods Which for 15 Years Have Saved Time and Expense and Prevented Mistakes

By JOHN G. ALDRICH

*President and General Manager New England Butt Company*

WHEN a company is engaged in the manufacture of machinery or equipment of a wide variety, and especially when certain customers require variations from the standard in the machines which they buy, the preparation, handling and final filing of orders becomes a matter of great importance. Our concern has developed a method of doing this work, which has operated satisfactorily with slight modifications under a Taylor system of management for a period extending back over 15 years. The system followed may be of use to other companies faced with similar problems in the filling of duplicate orders.

The New England Butt Company manufactures braiding, cabling, and many other types of machines for the manufacture of certain classes of textiles and wire products. The machinery used in this kind of work is of a special nature, and the products turned out in many of the textile and wire plants require machinery which is highly individualized. Hence it is very important that full information be recorded stating exactly the kind of equipment with which each customer is supplied, so that duplicate orders and orders for repair parts can be filled promptly and without error. No matter how inadequately a customer may describe the machine or part he wishes to duplicate we now almost always find it possible to supply him with what he requires by referring to the records made of his previous orders.

Incoming orders are numbered under two systems: One for complete machines and the other for repair parts. The orders are opened in the main office as received and after approval are turned over to an order clerk, who fills out an original as shown in Fig. 1. Data from the customer's letter is inserted and the order is checked with previous orders or with recent correspondence, if any, from this customer. When all the information necessary or possible from this source has been inserted the order clerk delivers the order to the engineering department.

If the order calls for complete machines it is O.K.'d for correctness by the engineering department and delivered to the planning department for typewriting. Eight copies in addition to the hand written original are prepared, as listed in Table 1. The entire nine are of a similar size and nature except for name and for the columns along the bottom of the sheet, Fig. 1. The two ticklers and the manufacturing order omit the spaces for: Issues written, passed, shipment complete, billed, and entered on record, and add spaces for the following: Routing, foundry tags written, time study, tags and orders written, route file prepared, and finished. The two cost orders have an entirely different footing from the rest of the copies and have special rulings on the back for the entry of complete cost data. The acknowledgment sent to the customer has no columns on the foot and on the back contains general statements regarding agreements and conditions. Table 1 shows the first and final disposition of these various copies.

SHIPPING ORDER — C

CHARGED TO / ORDERED BY: John Doe
SHIP PREPAID / COLLECT TO: John Doe, New York
VIA: Express
F. O. B.: Providence
SERIAL NO.:
TERMS: Net 30 Days
SHIP. ORDER NO. 38700
WEIGHT _____ HOW PACKED
DATE ORDERED BY CUST. MEM.: 4 / 5 / 26
SHIPPING ORDER ISSUED: 4 / 15 / 26
SHIPMENT DUE: 4 / 17 / 26
CUSTOMER'S ORDER NO. 40 REQ. 730

| Item | Quantity | Description | Drawing No. | Check | Pattern No. | Stock M'f'g Purch | Symbol | On Hand | Shipped |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 100 | #2 Change Gears 72T 16P 7/16" F | 11701-D-72 | | | WM | Rev. 11701-72 G2R | / | / |
| | | | | | | PM | | - | - |
| | | | | | | P | | - | - |
| | | | | | | | | - | - |
| | | | | | | | | - | - |

| CUSTOMER'S ORDER REC'D | | SHEET WRITTEN AND APPROVED | | ORDER WRITTEN | | DRAWINGS AND DATA CHECKED | | ISSUES WRITTEN | | MATERIAL APPORT'ND | | PASSED | SHIPMENT COMPLETE | | BILLED | | ENTERED ON RECORD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GL | | CSB | | MM | | CSB | | RT | | JS | | FG | RH | | DH | | JH | |
| DAY | HOUR | DAY | HOUR | DAY | HOUR | DAY | HOUR | DAY | HOUR | DAY | HOUR | INSPECTOR | DAY | HOUR | DAY | HOUR | DAY | HOUR |
| 4/15 | 1 | 4/15 | 2 | 4/15 | 3 | 4/15 | 2 | 4/15 | 3 | 4/15 | 3 | 4/15-3 | 4/15 | 4 | 4/15 | 5 | 4/15 | 5 |

FIG. 1. TYPICAL SHIPPING ORDER BLANK FILLED OUT FOR REPAIR PARTS

All order forms, B-81 to B-89, listed in Table 1, are of this general make-up except for extension of foot, as explained in the text. Actual overall size of each is 11 in. by 8½ in. The space back of "C" is used for recording machine symbol when the order is filled out for machines instead of for repair parts. WM, worked material. PM, materials "purchased" from the plant foundry (this is a separate business). P, materials bought outside. Checks at On Hand columns show (left hand) that material is on hand, (right hand) that it is all ready to ship.

TABLE 1. COPIES OF ORDER MADE AND THE FUNCTIONS THEY FILL

| No. | Name | Form No. | Color | When Filling Order | | After Filling Order | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Sent to | Filed | Sent to | Use | Filed |
| 1. | Original | B-81 | White | Shipping | Numerically | Planning | Permanent record | Machine orders by symbol Part orders—numerically |
| 2 | Shipping order | B-82 | White | Shipping | Numerically | Main office | Reference for future orders | Numerically |
| 3 | Tickler | B-83 | Blue | Engineering | Machine orders by symbol Part orders numerically | Destroyed | | |
| 4 | Tickler | B-83 | Blue | Gang boss | Machine orders by symbol Part orders numerically | Destroyed | | |
| 5. | Office copy | B-84 | Pink | Main office | By customer's name | Main office | Reference for future orders | By customer's name |
| 6. | Manufacturing order | B-85 | Yellow | Planning | Machine orders by symbol Part orders—numerically | Cost Dept. | Permanent record | Numerically |
| 7. | Cost-part order | B-86 | White | Cost Dept. | Numerically | Main office | Checking up ratios of costs to selling prices | Numerically |
| 8. | Costing and shipping order | B-87 | White | Cost Dept. | By symbol | Main office | Checking up ratios of costs to selling prices | By symbol |
| 9. | Acknowledgment | B-89 | White | Customer | | | | |

The order is then returned to the engineering department, in the case of complete machines, and the bill of material and the drawings are prepared. In the case of duplicate orders, or standard machines, these drawings and bills of materials are already on file. Where the customer calls for some variation over previous orders, or where he is asking for changes which have never before been introduced on any type of machine, new drawings and bills of material have to be made. All of the necessary drawings and data are then sent along with the order to the planning department where the stores and worked materials issues are written, the material is apportioned, the order is scheduled and routed, parts not in stock are ordered in, and manufacturing orders are sent to the shop.

In the case of repair part orders the drawings and data are checked and full information is entered on the original sheet before the order is typewritten. As orders of this kind usually call for parts carried in stock, the stores issues can be written, the parts delivered to the shipping room, and shipment made in most cases on the day the order is received.

The two fundamental elements which make the system successful are the accurate recording and filing of data regarding the company's products, and the method of filing the customer's previous orders. On each order is entered a complete and accurate description of the machine or part concerned. Drawing numbers, and wherever possible pattern numbers, are included on repair part orders for ready identification. The machine or part symbol is inserted on the order and is used for identification purposes throughout the entire process of filling it.

The engineering department maintains a complete file of original drawings or marked blueprints and bills of material, exhaustively cross-indexed in a card file so that every part previously made at any time for anybody can be quickly identified and located on the drawings.

The planning department files copies of each order permanently as shown in Table 1, machine orders by symbol and part orders chronologically by order number. In addition, on cards filed under customers' names, a record is made of the orders from each customer as they are filled.

In the main office two sets of orders are filed, one set numerically and separated into machine orders and part orders, and the other set alphabetically by customers' names. At the end of each year the two sets thus compiled form a complete record of the year's work. New sets are then started for the new year. The sets for five years back are kept in the main office for reference in filling future orders. After five years the sets are permanently filed in the company's vault in the basement.

It is, of course, impossible even to estimate closely the amount of time and expense saved by this ready reference file of previous orders. Almost invariably the file furnishes immediate information as to the exact machine or part wanted, even when the customer's letter or order is somewhat vague. The complete data entered on each finished order make it possible to write up new orders with a minimum of errors. The comprehensive record system of drawings, bills of material and card indexes in the engineering department eliminates an endless duplication of work and many costly mistakes.

The system adopted, therefore, instead of being conventional "red tape," is an accurate and direct method of filling new orders with the least expense, with absolute accuracy and with the utmost promptness. As a means of relieving plant executives from a mass of confusing details, as it has done in our case for over 15 years, it offers endless possibilities.

# Labor-Saving Equipment Feature New Westinghouse Air Brake Plant

## Foundry and Machine Shop Represent Latest Design

By G. W. WILDIN

*General Manager, Westinghouse Air Brake Company*

THE plant of the Westinghouse Air Brake Company is located in Wilmerding, Pa., a town of about 7000 inhabitants which has grown up around the factory. It has about 6000 employees and covers an area of 35 acres.

During 1924 the rapid expansion of the company's business necessitated a large increase in plant facilities and consequently a new foundry and machine shop building was planned and construction work started. This building, shown in Fig. 1, was completed in the latter part of 1925.

The new building is erected on a site at the west end of the property, formerly occupied by small storehouses. It is 920 ft. long, 76 ft. 8 in. wide at the machine shop end, 54 ft. wide at the foundry end, contains 233,500 sq. ft. of floor space (see Fig. 2), and is three stories in height. At the east end it adjoins one of the older foundries with which it has been directly connected, the crane runways being continuous between the new and old parts. The west end of the new building is devoted to machine shop work and to production of parts made of rubber, bakelite, and other substances which enter into the equipment manufactured by the company.

Each floor of the new building is divided at the middle by a permanent brick wall which separates the machine shop end from the foundry end. Where partitions of a more temporary nature are installed, they are of steel. Such partitions enclose shop offices, supply rooms, etc.

The roof is of monitor type. It is built of precast gypsum slab on steel framework.

The general construction is of brick on steel framework. Steel sash is used throughout with panes 14 by 20 in. in size. The lower row, which is at the height of normal vision, is of plain glass. The other rows are of hammered, ribbed glass, to better distribute the light and remove the glare.

Entrances are located at points for convenient transportation of materials. (See Fig. 2.) The building has four fire towers giving access to each floor and providing safe exits in time of emergency. These fire towers are built of brick, the landings and floors are of concrete, and the stairs are of concrete and steel with safety treads. Pipe hand railings are used. Doors connecting the fire towers with the plant are of steel. The exterior doors are fitted with wire glass in upper panels. All doors in the fire towers are hinged.

Between the two ends of the building are large doorways with doors of fire-resisting, tin-clad construction running on overhead track. Exterior doors leading from the plant are similarly operated, but are constructed of wood.

The walls, columns and other structural parts of

FIG. 1 NEW BUILDING AT WESTINGHOUSE PLANT. MACHINE SHOP IN LEFT END AND FOUNDRY IN RIGHT END

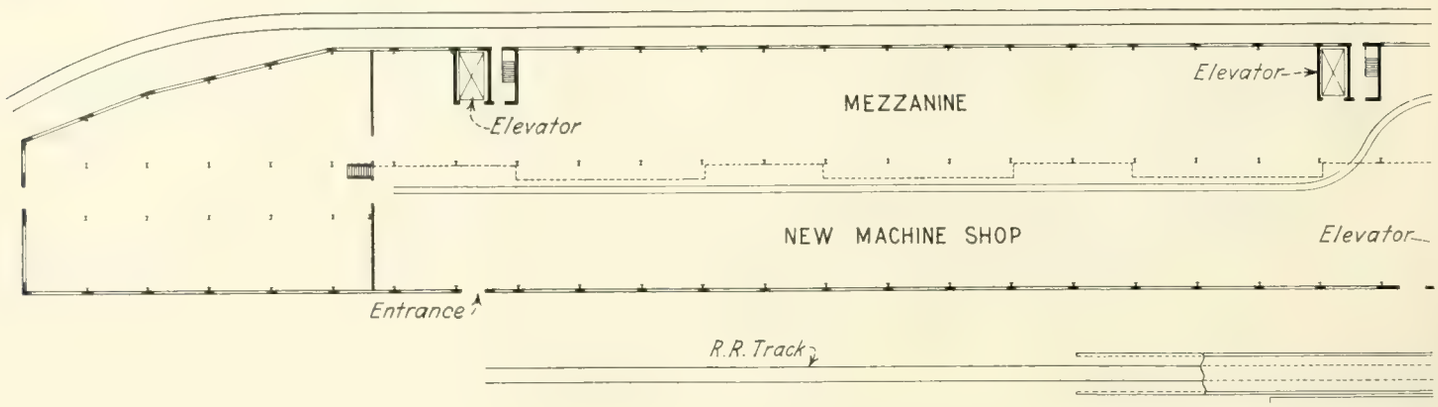



FIG. 2 DIAGRAMMATIC LAYOUT OF FIRST AND SECOND FLOORS OF

the building are painted with a black dado for a height of about 4 ft., up to the bottom of the windows. Above this point the brickwork and steelwork and also the ceilings are painted with aluminum paint in the foundry and mill white in the machine shop. The fire towers are painted in a manner similar to the building proper, namely a black dado about 4 ft. high along passageways and stairs, with aluminum paint above in the foundry, and mill white in the machine shop.

Power is supplied from the company's generating plant. Individual motor drive is used on all equipment. Compressed air is also supplied from a central plant located in the power house. This air is used for the molding machines and for sand blasting.

The lighting system is supplied with 110-220 volt a. c. current, generated in the company's power plant. Ceiling lights are used at centers of 20 x 35 ft. and are equipped with 500-watt lamps and RLM reflectors.

The building is heated by air. The heater consists of a large room or casing filled with multiple coils of small pipe, over which a current of fresh air from the outside is circulated by large fans. Exhaust steam from hammers in the blacksmith shop forms the heating medium. This steam is augmented by live steam as required. It enters the heater under a regulated pressure varying between 3 and 6 lbs. The heated air is blown through ducts passing under the first floor and connecting with risers about 40 ft. apart down the two sides of the building. Wall registers in these risers discharge the heated air at a level about 2 ft. above the floor and at intervals of 40 ft. down the sides of each room.

Although the building is constructed of fire-resisting materials throughout, as an added precaution protective equipment has been installed. Hose lines have been furnished at points of quick access in both the foundry and machine shop ends of the building. They are attached to special fire protection lines connected with pumps in the power house. A sprinkler system has been installed in the machine shop end of the building. Hand extinguishers are also provided at various points. The plant has its own fire-fighting organization and an alarm system.

Washrooms are of the latest and most sanitary construction. Multiple-type wash fountains are used. Steel lockers are provided for each workman and are erected on concrete platforms six inches above floor level so that the rooms may be washed by hose. Ample shower bath equipment has been installed in the washrooms on the main and second floors.

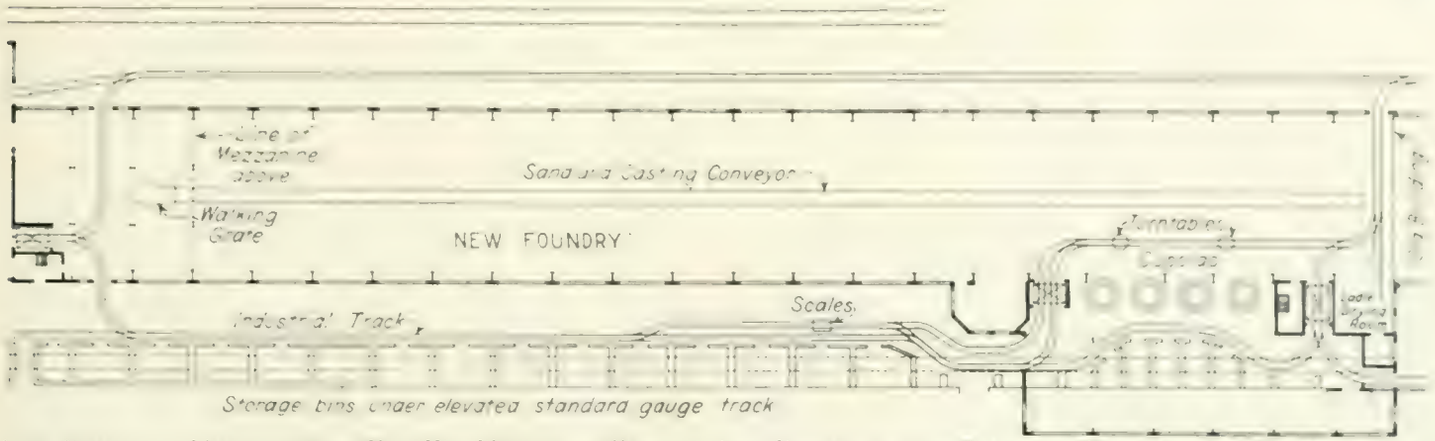
FIG. 3 FIRST FLOOR OF FOUNDRY WEST FROM CUPOLAS

Wall type drinking fountains have been located at frequent intervals throughout the entire building.

Safeguards are used wherever possible on machinery. The open type of construction adopted and the excellent lighting in the building of themselves assist in eliminating accidents. The plant hospital, under the constant supervision of a doctor assisted by nurses, provides treatment for any injuries which may occur.

In the machine shop end, the first and second stories each have a mezzanine floor extending down the north side. On the first floor are punch presses for sheet metal work and vulcanizers for the manufacture of rubber cylinder cups, gaskets and similar "Wabco" products. On the first mezzanine the rubber gaskets for air brakes and molded insulations for other products are built.

On the second floor Brousousse type air compressors, rubber air brake hose, and leather gaskets are made. The second mezzanine is used for the manufacture




NEW BUILDING—MACHINE SHOP END HAS MEZZANINE FLOORS—SAND RECLAIMING AND PREPARING EQUIPMENT ON MEZZANINES IN FOUNDRY END OF BUILDING

of molds and dies. The third floor is devoted to the manufacture of train control apparatus.

The first two main floors are equipped with overhead cranes which serve these floors and also lift material to a series of balconies delivering it to the mezzanine floors. Other features of particular note are the equipping of all machines with individual motors, the use of sheet metal partitions for all shop offices and enclosures, and the installation of wood block floors.

In one of its foundries about thirty-five years ago the Westinghouse Air Brake Company installed the first complete system of mechanical mold handling equipment used in the United States. This installation, made by the Link-Belt Company, has been in constant service ever since it was placed in operation. As improvements in foundry methods and machinery have been made they have been adopted by the West-

FIG. 4—PAN CONVEYOR, CRANES, AND SAND RECLAIMER EQUIPMENT

inghouse Company. The flexibility of the handling equipment has kept it in pace with these modern developments and its capacity has been ample for all production demands. Hence the original installation, with slight modifications, is still functioning satisfactorily in its original location.

When planning its new building, the Westinghouse company once more pioneered in labor-saving developments. The foundry end of the building is laid out and equipped according to the most up-to-date practice and again Link-Belt mechanical handling equipment has played a major part in the design. Molding and casting are done on both the first and second floors. The third floor is used entirely for core-making.

The outstanding feature of the foundry is its provision for mechanical handling wherever possible. Limestone, coke and sand are delivered in railroad cars on an elevated siding at the south side of the building. They are dumped from hopper cars into bins beneath the track. Pig iron and scrap are likewise delivered on this siding and are removed by a magnet operated from an overhead traveling crane. These materials are loaded on small industrial cars as needed, by magnet in the case of the iron, and the cars are moved by manual labor into the building.

They are delivered into the receiving room on the first floor back of the cupolas. Here they are run onto freight elevators and taken to the second or charging floors, in the case of limestone, coke and iron, or to the third floor bins in the case of core sand. Sand for molding is delivered either on the first or second story to the pan conveyor system, which will be described further on.

Complete sand preparing and reclaiming systems are located on balconies above the first and the second foundry floors, at the middle of the building adjoining the machine shop end. Used sand from the molds and new make-up sand are delivered to these systems by means of pan conveyor equipment traveling down the entire length of each floor and discharging onto shaking grates. (See Figs. 2, 3 and 4.) This sand is sieved, raised in bucket elevators to the top of the equipment, seasoned, tempered, reconditioned, thoroughly mixed and delivered to endless belts made of a special tough, flexible and wear-resisting quality of sheet steel. One of these belt systems runs up each side of the molding floor the full length of the foundry. The supporting framework and rollers for the belts are carried on the steel columns. Belts are visible in Figs. 3, 4 and 6.

Molding machines are located along the walls at close intervals on each side of the room, except by the cupolas. Each machine has above it a hopper capable of holding three tons of molding sand. The sand is discharged into these hoppers from the steel belts by means of plows on the belts just above the

FIG. 5 CHARGING FLOOR

hoppers, to deflect the sand off on both sides. These plows are operated by hand. Back of each belt line there is a walkway and an operator watches the hoppers and fills them when necessary by lowering the individual plows on the belt. When not in use the plows are thrown up out of the way by levers.

Four Whiting 96-in. diameter continuous melting cupolas are installed in the foundry, each capable of melting 20 tons of iron per hr. Limestone, coke and iron are delivered on small cars from the storage yard to the charging floor back of the cupolas by means of the elevators shown in Fig. 2. These industrial cars are run onto a transfer car carried on tracks along the rear of the cupolas. (See Fig. 5.) If the material is to be temporarily stored the industrial cars are pushed from the transfer car onto tracks on the back part of the charging floor. If the charge is to be fed directly into the cupola the transfer car is run along to the proper point and is then pushed off on a track alongside of the cupola. Iron is fed into a charging door on the right-hand side of the cupola and coke and limestone are charged on the left. A pneumatic charging machine tips the car and allows the material to run out into the cupola. Empty cars are taken back to the elevator and down again for filling.

The molten iron is delivered from the tapping spout in a continuous stream. The end of the spout is equipped with a two-way delivery chute which can be tilted in either direction at right angles to the main spout. (See Fig. 6.) While a ladle is being filled at one end of this swivel chute an empty ladle is placed at the other end. When the first is filled the cupola tender throws a lever and inverts the delivery chute so that it discharges into the empty ladle.

On the first floor of the foundry four overhead traveling bridge cranes and ten overhead traveling wall cranes, five on each side of the building, serve the molding machines as necessary and carry the ladles of molten iron for casting. A monorail telpher serves the cupola itself with ladles, and delivers full ladles to the bridge cranes for pouring. The molds are made on jar ramming or on jolt and squeeze machines close against the wall and patterns are drawn on small trucks running on tracks in front of each machine. In some cases these small trucks are electrically driven. The molds as made are lifted from these tracks by the overhead cranes and set on the molding floor where they are finished, the cores are inserted and the copes put in place.

After the iron has been poured and the castings have set the copes are removed. When the castings have cooled sufficiently they are dumped with the molding sand on a 4 ft. 6 in. wide pan conveyor 400 ft. long, running down the entire length of the foundry, just below the floor level. (See Figs. 2, 3 and 4.) The heavy castings are removed at the lower end of the conveyor for cleaning. The lighter castings, which do not break easily, and the used molding sand are

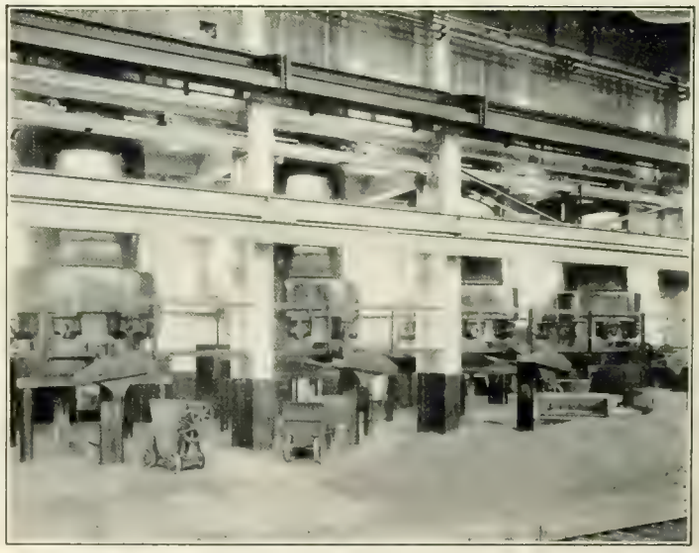


FIG. 6 FRONT OF CUPOLAS

carried by the conveyor up an incline and discharged onto a walking grate. The sand falls through this grate and the good castings, gaggers, risers and pieces of scrap metal, are carried to the end of the grate and removed. The sand goes through the reclamation process previously described and then back to the hoppers above the molding machines for reuse.

Tumbling barrels, sand blast mills and grinding wheels are located at the sides of the room where the castings are delivered. After cleaning and grinding, the castings are loaded on trucks and carried either into the adjacent machine shop or over to the large main machine shop for the succeeding facing, boring and drilling operations.

The layout and equipment on the second floor is

very similar to that on the first, both having the molding machines along the walls served by sand delivering apparatus, and both being equipped with the long pan conveyor carrying sand and castings to the lower

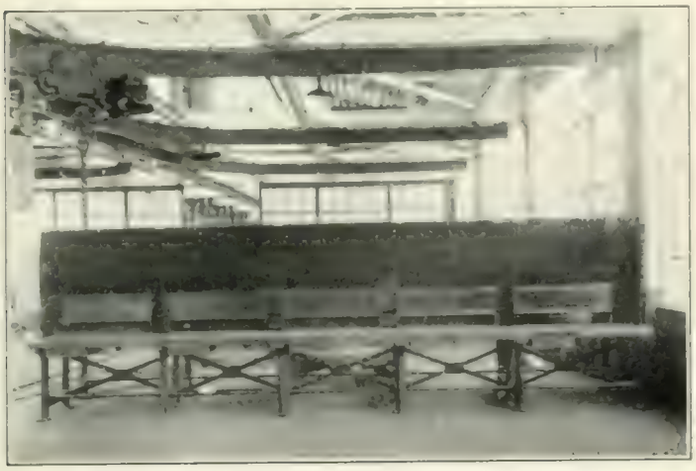


FIG. 7 CORE BENCHES AND MONORAIL HOISTS

end of the shop. To get iron up to the second story a circular hatchway has been provided in the floor. An underslung crane lifts the ladle up through this hatchway and transfers it to any one of four monorail hoists which carry it to the molds for pouring. Four overhead trolley systems running the entire length of the department carry these monorail hoists. Tumbling barrels, sand blast mills and grinding wheels, are installed at the west end of the floor.

The entire third floor of the foundry is devoted to core-making and in this department, as in the others, the very latest and best equipment is used. Core sand

FIG. 8 ONE SECTION OF CORE OVENS

is delivered in railroad cars and discharged into the bins under the elevated track where the other materials come in. It is loaded into buckets on industrial cars, which are then run into the building and on an elevator. The cars are taken off on the third floor and delivered to bins at the end of the building. Here a monorail hoist lifts off the buckets and discharges the sand onto dryers composed of small pipes through which steam is circulated. As the sand dries it falls into the bottom of the bin.

The sand is removed as required and put through sand mixers where clay and core oil are introduced. It is then loaded into bottom-dump buckets and carried by a system of monorail hoists to the core benches. (See Fig. 7.) Ten men work at each core bench, five on a side. In front of each man is an overhead bin carried on the bench. The buckets of sand are discharged into these bins by the hoists. Practically all the cores for air brake and related equipment are composed of small parts and these parts are made at the individual core benches. They are loaded as finished on steel racks placed back of each of the workmen. When these racks are filled they are run over to the core ovens by an electric truck.

Cores are made at the two ends of the department, the west end being fitted up for girl core-makers. The ovens are in the middle and are equipped for either gas or oil-firing. (See Fig. 8.) Each oven is equipped with a recording pyrometer so that the baking process can be kept under control. Baked cores are delivered to assemblers who fit them together accurately. Much of this work is of a very exact nature and must be performed with the aid of jigs.

The finished cores are again loaded on trucks and are delivered to the first and second floors where the molds are made.

In order to facilitate the removal of dust and fumes from the foundry the building has been equipped with an exhauster installation system consisting of seven 15,000 cu. ft. per minute fans taking air from the first and second floor ceilings and discharging it to the atmosphere. Ducts with inlets extend down the center of the ceilings and the dust and fumes are drawn through them and discharged by the fans. Natural ventilation is also provided by means of ventilating sections in the window sashes.

At points where the sand passes through shaking grates over which the castings are delivered for cleaning, and on all grinding, sand blasting and tumbling operations on castings exhausters connected to a dust arrester system are provided. These ducts discharge into a dust separator installed outside of the building on the north.

All foundry floors are of concrete, finished with a composition of cement mixed with sieved iron filings to give a hard surface which will resist abrasion.

The washrooms and toilets for the foundry are in a wing of the building on the south side and are divided off from the main structure by brick partitions. The heating room and the receiving room for materials leading to elevators delivering them to upper floors in the foundry are located in this wing on the main floor. The blowers supplying air to the cupolas are also installed in this wing, midway between the first and second floors.

Girls are employed for light work in the core-making department. On the top floor of the building a com-

bination rest and lunchroom has been provided for them.

The new building was designed by Bernard H. Prack, architect and engineer, and was constructed by the Stone and Webster Co.

TABLE 1. SUMMARY—WESTINGHOUSE AIR BRAKE PLANT

| | |
|---|---|
| Location | Wilmerding, Pa. |
| Construction | Steel framework and brick walls on concrete foundations. |
| Grounds | Building is one of a large group of manufacturing structures comprising the plant and is built on the site of former storehouses. |
| Building, size | 920 ft. long and divided into two sections as follows: Machine shop 460 ft. by 76 ft. 8 in. and foundry 460 ft. by 54 ft., each section 3 stories high. Machine shop end has mezzanines on the first and second floors. First and second floors of foundry are used for molding and casting; third floor for coremaking. |
| Architecture | Industrial, specially adapted to foundry and machine shop work. |
| Neighborhood | Industrial, located a short distance from business and residential sections. |
| Employees | 6000 in entire plant. 850 at present in departments of new building, 170 of the latter being girls. When running full about 300 additional employees will be needed. |
| Transportation facilities | Sidings from the Pennsylvania Railroad serve the entire plant. Tracks run along the north and south sides of the new building. The latter track is elevated and the space beneath is used for the storage of material. |
| Entrances | Four fire towers located as shown in Fig. 2. Three yard entrances for materials are located along the north side and similar entrances along the south side. The east end of the building connects directly with the already existing foundry building. |
| Windows | Steel sash, the major portion of which is seven panes high and is installed in groups of three sections, each five panes wide. |
| Glass | 14 x 20 in. panes. The lower row at the line of vision in each sash is transparent. The rest of the glass is of hammered ribbed type. Wire glass is used in the fire towers for windows and exterior doors. |
| Doors, exterior | Outside doors in fire towers are of steel with wire glass in upper panels, and swing on hinges. Large doors opening from shops into yard are of wood and run on overhead tracks. |
| Doors, interior | Between machine shop and foundry the doors are of tin-clad fire-resisting type and run on overhead tracks. Doors to fire towers, heater and blower rooms, toilets and wash rooms, shop offices, etc., are of steel, and swing on hinges. Office doors have glass panels. Elevator doors are of special fire-resisting construction. |
| Roof | Precast gypsum slab. |
| Ventilation | Seven 15,000 cu. ft. per min. motor-driven fans exhaust dust and smoke from ceilings of first and second foundry floors through ducts with inlets at frequent intervals, and discharge them at roof level through seven flues on the outside of buildings. Windows have ample ventilating sash (see Fig. 1) operated by worm gear drive. |
| Walls | Brick. |
| Painting | Dado of black paint extends from floor to bottom of windows in shops, and about 4 ft. high on all columns. The rest of the interior—walls, columns, ceilings and structural work—is painted with aluminum paint in the foundry and mill white in the machine shop, for cleanliness and reflection of light. Stairways have black dado for height of 4 ft. and aluminum or white paint on rest of walls and ceilings. |
| Floors | Reinforced concrete in foundry, finished with a special surfacing of cement and iron filings to resist abrasion. In machine shop end the main and mezzanine floors are of 2½ in. wood block, set on end on a concrete base. |
| Ceilings | Concrete—the under side of floors above. |
| Partitions | The two main portions of the building are separated by a permanent brick wall, with fire doors connecting departments on each floor level. Fire towers, blower room, heater room, charging floor, receiving room for incoming material, and wash and toilet rooms, are likewise separated from the main building by brick partitions.<br>All partitions for shop offices and similar enclosures are of steel and glass, painted olive green. Store and tool rooms are set off by partitions of steel and wire mesh. |
| Stairs in fire towers | Concrete on steel framework, with steel risers and cast iron safety treads. Black pipe hand rails. |
| Lighting | Overhead system of 500-watt Mazda C lamps on centers of 20 x 35 ft. RLM reflectors. Local units on core benches and some machines. |
| Heating | Hot air system. Air is drawn from outside into heater casing by two fans, one of 20,000 and the other of 30,000 cu. ft. per min. average capacity, and is passed over pipe coils supplied with exhaust steam from blacksmith shop hammers. Pressure regulated to between 3 and 6 lb. gage. Live steam automatically added as make-up, when necessary. Heated air is then blown through ducts beneath first floor into risers connecting with all floors. Wall registers 2 ft. above floor and at approximately 40 ft. centers distribute the air. About 65 deg. temperature is maintained in the machine shop and 55 in the foundry, which is also partially warmed by the heat from cupolas and the iron during casting. |
| Power facilities | Main power plant furnishes power at 440-volts a. c., or 2200 volts a. c., 3-phase, 60-cycles, for use on motors driving machines, at 110 and 220 volts a. c., 3-wire system, for lighting circuits; and at 110 or 220 volts d. c. for use on cranes and variable speed motors. |
| Compressed air | Furnished at 175 and 125 lb., both high and low pressure, from the main power plant and used in molding machines, sand blasts, etc. |
| Water | Supplied by main plant system and piped to wash and toilet rooms, drinking fountains, and to all points where needed in manufacturing processes. Drinking water is cooled in a refrigerating system serving the entire plant. |
| Motors | Individual drive used for all machines, sand reclaimers and mixers, fans, blowers, etc. |
| Chain drive | Used on parts of sand reclaiming equipment. |
| Cranes and hoists | *Machine shop.* Two bridge cranes, 5 tons capacity, on the first floor and two on the second floor transport materials and lift them to a series of balconies serving the mezzanine floors.<br>*Foundry—first floor.* Four 5-ton, 51 ft. 1½ in. span, overhead traveling, cage-operated bridge cranes (two of which were in original foundry adjoining new building) handle heavy work.<br>Six 3-ton, wall, cage-operated cranes—three on each side, running on tracks below the bridge cranes—with 25 ft. overhang to reach conveyor down middle of shop floor (four were originally in adjoining foundry) handle ladles and molds and shake out castings.<br>One monorail telpher handles ladles at cupolas.<br>*Foundry—second floor.* Four 3-ton monorail, cage-operated hoists running on separate overhead trolley systems are installed for handling molds, pouring and shake out service. Underslung crane is provided to hoist ladles from first floor and deliver them to monorail hoists.<br>*Foundry—third floor.* Two 1½ ton monorail cage-operated hoists to lift core sand buckets off industrial cars and empty them, to feed sand mixers, and to deliver prepared core sand to core benches. |
| Electric trucks | One used on core floor to move racks to and from ovens. |
| Industrial trucks | All incoming materials and outgoing products are handled on trucks running on tracks, such as shown in Fig. 5. A large number are used to carry molding and core sand, limestone, coke, pig iron, blacking, core oil, etc., to their respective points of use within the building. |
| Elevators | Three of 10,000-lb. capacity each in the foundry, one each side of the cupolas and one at the machine shop end of the department. The machine shop has two similar elevators. Elevators have track to run industrial cars on. |
| Conveyor systems | Pan conveyors, 400 ft. long, run down the center of the first and second foundry floors, to carry castings to cleaning departments, and convey molding sand to the reclaimer outfit. First floor conveyor is 4 ft. 6 in. wide and second floor conveyor is 3 ft. 8 in. wide. (This is width of floor opening for conveyor. Pans are a little wider.) Long overhead conveyor systems of imported endless steel belt running down the entire length of both sides of the first and second foundry floors deliver sand from the mixers to storage bins over the molding machine. |
| Sand preparation | Independent systems on first and second floors. Used sand from pan conveyor system falls through walking grate at end of foundry, is sieved, delivered by bucket elevator to storage and seasoning bins, is tempered, reconditioned, prepared in sand mixers and discharged into storage tanks. From there it is delivered to the endless steel belts carrying it back to molding machines. |
| Dust and fume collectors | Exhausters over walking dump grates, sand reclaimer equipment, casting grinders, tumbling mills and sand blasts convey dust into a separating chamber outside of building, where it is precipitated by canvas baffles through which air passes to atmosphere. Separator structure is at second story level and refuse is discharged into railroad car beneath and removed to dump. |
| Cupolas | Four Whiting continuous melting cupolas, each 96 in. diam. inside of steel shell. Equipped with tilting spouts for continuous pouring. Capacity, 20 tons per hr., each. |
| Charging machines | One on each side of each cupola; left for limestone and coke, right for iron. Pneumatic operation. |
| Blowers | Three positive pressure blowers deliver 12,000 cu. ft. of air per min. at 16 oz. pressure to cupolas. |
| Core ovens | Fifteen oil or gas-fired ovens installed for core drying with space for six more, and four ovens of drawer type for very small cores. |
| Core benches | Totally new type. Made of steel with 3 in. plank tops; space for five workmen on each side. Hoppers on benches hold supply of core sand which is replenished by traveling monorail hoists. |
| Sprinklers | Complete system in machine shop end. |
| Fire extinguishers | Hand type at convenient points. |
| Fire-hose | Numerous installations of equipment connected to central high pressure water system operated from pumps in power house. |
| Watchman's system | Clock system. Also night light system. |
| Storage shelving | Steel adjustable type used throughout. |
| Storage racks | Steel construction. |
| Factory benches | Steel legs, wood tops covered with galvanized sheet iron used in machine shop end. (See core benches. The latter are the only equipment of bench type used in the foundry end.) |
| Factory stools | Steel legs, wood tops. |
| Factory office furniture | Flat top desks, chairs, filing cabinets, etc., all wood. |
| Safeguards | Moving machinery guarded by wire mesh on steel framework wherever possible. Railings on platforms and walkways prevent falls. |
| Hot water heaters | Located in washrooms. Heated by exhaust steam. |
| Toilet rooms | Two on each floor for foundry. Same for machine shop. |
| Washbowls | Porcelain, multiple type, for six persons each, with mixing faucets and liquid soap holders. |
| Closets | White porcelain. |
| Urinals | White porcelain, floor type, 24 in. centers. |
| Shower baths | Located in main washroom on third floor and in second floor toilet room. |
| Toilet partitions | Steel, enameled olive green and set 12 in. above floor. |
| Lockers | Individual steel lockers in main wash rooms and in second floor toilet rooms, set on 6 in. high concrete platforms to permit washing of floors by hose. |
| Drinking fountains | Wall type bubbling fountains at convenient intervals throughout the shop, supplied from the plant refrigerated water system. |
| Plant communication | Telephones in shop offices. |
| Time system | In and out check board system used. |
| Hospital equipment | Service furnished by a central hospital for the entire plant. |
| First aid equipment | Metal cabinets with complete equipment. |
| Rest rooms | On third floor, rest and lunch rooms for girls. Facilities for hot lunches—small gas stoves, percolators, etc., and porcelain top lunch tables with stools attached. |

# Major Results of Budgetary Control

## As Secured by Armour and Company

By W. S. CLITHERO

[illegible]

IT is just about two years ago that Armour and Company installed budgets generally. At that time no one in the organization, besides a few of the head executives, felt that there was any crying need for budgets. But it has been interesting to watch general indifference change and slowly develop into enthusiasm, until today it is safe to say that the Armour organization as a whole is strongly committed to our budget program.

Some of the benefits of budgets which we have experienced are discussed in what immediately follows. In order to make clear how these benefits came about, an outline will be given of the preparation of one of our chief budgets—the Expense Budget.

**Armour and Company has annual sales of approximately $900,000,000; the production and marketing operations that this huge sum represents are under budgetary control. These budgets have been instrumental in setting a goal; have helped to co-ordinate all activities; have forestalled losses; make for consultation and agreement before action; are an instrument to reduce costs and expenses, as a 5 per cent reduction in unit costs in one year; teach consideration of factors that affect prosperity.**

First of all, the budgets have been instrumental in setting a goal. The owner of a business usually has a clearly defined objective for the attainment of which he will exert his best energies. It is, however, necessary that the general objectives of the head of a business be known all the way down the line, and also that each individual knows the part which it is necessary for him to play in order to attain the common goal. Armour and Company, for example, through its budgets one year set up a goal of a 5 per cent reduction in unit costs. F. Edson White, president of the company, made an appeal to the whole organization to endeavor to accomplish this reduction in expenses. The definiteness of this objective helped greatly toward accomplishing it. All through the year the test applied to results was a simple one—is there a 5 per cent reduction in unit costs.

The preparation of the budgets is usually the occasion, or opportunity, for acquainting the organization as a whole with the objectives of the various heads and various departments. When the budgets are made up the foremen in the plants and the salesmen in the branch houses and car routes are asked to set up a definite goal for the coming budget. In the case of the foremen in the plants, each one is asked to estimate what the maximum is that he can do under the conditions which will probably exist. In the case of the salesman in the field, his manager or superintendent is asked to consult with him in order to decide what may be expected from the salesman during the budget period. The budgets are the occasion for each man to plan his work with the assistance of his next superior and for clearly committing himself to accomplish that which in his own judgment he thinks should be done. These budgets, which contain the objectives of the organization, apply to tonnage and to expenses.

The preparation of the budgets has, therefore, resulted in much more definite objectives for the company as a whole, and in a clearer understanding by each branch of the business as to what was expected of it as its contribution toward attaining the goal.

Our method of having the operating departments prepare the budgets, (as distinguished from another method which might have been followed, namely, to set the budgets at the general office and tell the operating departments that they were expected to do that,) permits us to be more insistent that the budgets be attained. Of course, the budget estimates prepared by the operating departments are subjected to a very careful scrutiny in order to determine whether they are reasonable or not, and there are frequent requests for revision, the reasons always being clearly stated. In a certain sense, then, the final budget is frequently not entirely the objective which the operating department has set itself, but it is the result of consultation with the general management and usually represents a figure with which all parties concerned are satisfied. We therefore feel at liberty to press fairly hard for the attainment of the budget. In a real sense the budget represents a self-set goal, to which the operating departments may fairly be held.

Another benefit in the preparation of the various budgets is that it helps to co-ordinate the various activ-

ities of the business, particularly a large business. Business units have become so large in the present industrial age that proper co-ordination is a very serious administrative problem. An article written by Oliver Sheldon[1] excellently states the difficulties of management in a large company.

> In every concern above a certain size, the problem of linking together all the various activities into one flexible machine is becoming increasingly acute. . . . The same story can be told of many concerns. When it was small, everybody knew the aim and object of the work; every one was in touch with every one else, and the highest executives were in constant contact with each other and with the staff. Now, the business has developed; the work which formerly a boy performed now occupies the time of a large department; work which in the old days was carried out satisfactorily by one officer is now split up among a dozen, each with its own staff; the heads of the concern scarcely know what the various departments are doing from day to day, and the departments know little enough of what the heads are aiming at and planning to achieve; responsibilities have been widely delegated, so that junior executives are now deciding questions which formerly perhaps would have received the attention of the board of directors. As the business has grown co-ordination has become increasingly urgent. . . .

Is it not a fact that a great number of firms simply grow up like Topsy without well defined policies and plans? And, as pointed out, a lack of co-ordination and well defined plans is a serious obstacle impeding the progress of many companies in this day of keen competition.

Budgets compel executives to think through their plans and formulate policies which, through the preparation and revision of the budgets, are automatically transmitted to the organization, and especially to those in the organization who need to know these plans and policies. This cannot fail to result in co-ordination.

As pointed out also in the quotation, in a company when it was small and directed by one man it was possible for him to be in close touch with every phase of the business, and to formulate its policies and personally tell them to those in the business who needed to know.

In this modern day, however, the size of business is so much greater and competition so much keener that more formal means are necessary to make clear the future plans of the various parts of a business. Budgets outline the fundamental policies of a business or industry.

Moreover, in the day to day course of a business an executive O.K.'s various transactions which, taken individually, appear of minor importance and an executive busily engaged in directing the day to day business cannot be censured if he loses his perspective. That is where the budget comes in—budgets give a picture of the business as a whole and show where it is headed.

### The Forestalling Element

A distinct merit of budgets is that they endeavor to forestall rather than correct losses. The work of the accounting department in most concerns is to make *post mortem* examinations, that is, after a transaction or series of transactions has occurred, the accounts reflecting actual cost are examined, and from that examination the accountant determines, by analysis and the application of certain standards he has set up, how efficiently or inefficiently the work was done. You will note, however, if the company's operations were inefficient and damage was sustained, that all the accountant can do is to agitate the question sufficiently with the executives so that they take action to prevent a recurrence. Budgets, properly installed and administered, would probably have forestalled the loss. We hear much today about preventative medicine in the medical world, and that is what budgets are to business.

The very nature of budgets and the preparation of budgets make for consultation and agreement before something is carried out. Without budgets it frequently happens that something is done about which there is thought to be no question, but when it has been executed, meets with much disfavor because it does not fit in with the general policies of the company or for some other good reason. Misunderstandings of such kind are clearly lessened by our budgets.

### Reduction of Expenses

President White in his public comments has several times stated that the budgets have been the instrument by which very considerable reductions in expenses have been effected. It should be noted that the Budget Department did not bring about this reduction in expenses, but that the Armour organization itself reduced expenses, and that the budgets were a very effective device in bringing this about. The cost accountant in one of our chief expense departments recently commented that since the budgets were installed and costs estimated in advance, everyone in the department is talking more about unit costs and expense and the necessity of reducing expenses than ever before.

Another benefit from our budgets is that they are teaching our organization to think about those factors which affect our prosperity. Our budgets are teaching always to relate expenses to tonnage, etc., rather than to think of either independently with the result that they fail to hold their proper relation.

### Preparation of a Typical Budget

The foregoing briefly summarizes the benefits which the Armour organization has received from the budgets which have been installed. The point at which these benefits originate will be reasonably clear in the following description of the procedure of preparing an expense budget. The work we do on the expense budgets can be divided under the following headings: 1. Relating sales and production to expenses. 2. Preparation of an expense budget. 3. Approval of expense budget. 4. Control of expense budget.

[1] Organization Manager, Rountree and Company, Ltd., York, England. See the Harvard Business Review.

1. *Relating sales and production to expenses.* The two activities of business which ordinarily entail the largest expense are production and selling. Since sales and production fluctuate greatly, sales and production expenses vary considerably. Sales of most concerns are governed largely by the intensity of the selling effort, by price changes, and by the condition of the market. Sales on a date not far in the future, can be determined with fair accuracy in most businesses. Most enterprises have (a) a definite trend, either of growth or decline, (b) a definite seasonal movement, (c) fluctuations in sympathy with the general prosperity of the country, and (d) fluctuations resulting from providential conditions or arbitrary acts by individuals. In order to estimate sales at a future date a study must be made, particularly, of the first three factors.

### Factors That Affect Sales

Two other factors which affect sales considerably are prices of the product, and intensity of the selling effort. Therefore price movements and selling policy should be known at the time the sales estimates are made.

Production usually bears a definite relation to sales. But production expense, because production usually takes place at a different time from sales, will not necessarily be high at the same time that sales expense is high. The normal time relation between sales and production can be determined. This preliminary study of sales and production will permit the calculation of the probable expense resulting from these two activities.

Our expense budgets, of course, cover all expenses or at least all controllable expense. By devoting attention particularly to sales and production expenses, because of their importance and the extent to which they should fluctuate, it is not implied that other expenses are not budgeted.

2. *Preparation of expense budget.* First of all, expense budgets are drawn up in terms of units of responsibility, that is, the various distinct activities in the business are demarked, and budgets compiled by the departments or persons carrying on this activity, with the acknowledgment that they are definitely responsible for the activities and for the budget estimates on those activities.

We are very careful in preparing the expense budget to decide who is to make the estimates. Preferably the actual operating men should do this. Expense figures which they have set themselves are not likely to be exceeded as soon as are estimates from the home office. The field man is like the head of a department in a department store who not only controls the selling but also the buying for his department. If someone else has bought the goods he can excuse any failure to sell satisfactorily by saying that the buying had been wrong. But if he has charge of both buying and selling he is committed to selling the goods which he buys. The same holds true when the operating departments prepare expense budgets. There is no blaming someone else in case expenses exceed the estimate.

It is worth while to illustrate from our experience what endeavor is made to commit the organization to its production and expense budgets. After consultation between Chicago and the general manager of each packing house, the production volume estimate is decided on by periods. Thereupon the general manager transmits the production estimate to the superintendent of his plant. The superintendent, in turn, calls in his foremen and advises each foreman as to his production volume. The foreman then gives the superintendent an estimate as to what his expense per hundred weight by periods will be. The superintendent and his assistant go over these estimates causing revisions where it is deemed necessary, and submit their budget on production expense to the general manager. If satisfactory to the general manager, he approves the budget after the superintendent has approved it, and then transmits the budget to the general office in Chicago where it is submitted to the production manager for his approval or revision, who finally submits it to Mr. White and the General Budget Committee.

### Methods at Sales Branches

The same thing is done at our sales branches. Each branch manager first appraises the local sales possibilities and estimates his sales by periods for that branch. In doing this he builds it up step by step. He consults with each salesman and they arrive at an individual sales budget for each member of the selling force. Also any other member of the house organization who sells goods including himself. He then arrives at his total sales budget and is ready to estimate the expenses required to handle economically and efficiently the estimated sales. He calls in his office manager and makes an estimate on the office salaries and other office expenses. He estimates the salaries for his salesmen and other controllable expenses. After he has arrived at the total expense and consulted with those who have the responsibility of the spending of the money he arrives at the total expenses for the branch. The next step is to calculate his cost to market per hundred weight. This is the standard by which he judges how well the budget has been made. If it is out of line he must go back and make revisions. After the manager approves the budget he sends it to his district superintendent. The district superintendent passes on the budget and sends it into Chicago for his territorial supervisor's approval. The territorial supervisor passes on the budget and submits it to the general branch house superintendent who in turn passes it on, after he has approved it, to the vice-president in charge of branches who, in turn, passes on it, and submits it to Mr. White, and the General Budget Committee. This method of building up a budget step by step brings everybody in the organization into the picture and it extends up through the

organization from the foreman in the packing house and the salesman in the branch house to Mr. White.

This sort of a preparation of a budget is not detailed paper work, but is a real opportunity for the executives to sell their objectives to their men.

3. *The approval of expense budgets.* After the expense budgets have been drawn up by the field or operating departments, the budgets are sent in with other budgets for approval and consolidation in one master budget at the general offices of the company. The likelihood is that in several respects the budget estimates do not harmonize. Immediately it becomes necessary for the general management to determine which plan is the most desirable. Some budget estimates will have to be returned with a request for revision or for a satisfactory explanation of the original figures.

It may be *apropos* to remark that in analyzing the expense estimates it should never be forgotten that there are times when an uncompromising attitude must be taken in regard to a reduction in expenses. This is particularly true after a long period of prosperity when many extravagances have crept in. And then in many businesses there are definite trends towards more efficient production and distribution. Failure to keep pace with this trend will result ultimately in the failure of the company. After all, expenses are able to make or unmake any business.

4. *The control of expenses through budgets.* After the expense budgets have been prepared and approved periodically, usually month by month, the actual expenses are checked against the budget estimates. Failure to do this and failure to call the operating department to account for any expenditure greater than the budget will ultimately end in the budget being a joke or a harmless piece of red tape. It is, of course, recognized that there are always some unforeseen expenses and unexpected conditions which require revision of budgets up or down. But expense budgets are worth little unless there is a sincere endeavor to carry them out. It takes determination to carry out the right kind of an expense budget.

### Limitations of the Budget

The objections which executives make to budgets have varying degrees of merit. The objection which usually has the least merit is that budgets are usually nothing more than guesses and not worth the making. It is true that business is beset with many uncertainties of a providential and arbitrary nature, but surely the mere fact that uncertainties exist cannot be advanced as a good reason for failure to plan ahead or budget. The uncertainties of business are not a good reason for not planning—just exactly the opposite—they are the reason for planning or budgeting. Is it not a fact that these uncertainties when analyzed are not nearly so great as claimed? It is better to use the best means at hand to analyze them and budget ahead rather than simply drift along. To refuse to plan ahead in your business, because of an uncertain element, reduces your business policies to an absurdity.

Another objection from executives is that budgets are too expensive. The obvious answer is that most concerns that install budgets expand their program rather than discontinue the budgets. Our experience is that budgets have paid their way a hundred fold. Armour and Company has annual sales of approximately $900,000,000. Our budget program embraces the company as a whole. We have only six or seven people in the budget department.

Another objection is that the organization generally and the executives and sales force particularly are too busy to be bothered with budgets. The answer can be made that in thinking out plans for the future the organization generally and executives and sales force particularly are only doing that which should always have been done and the only extra work is the setting down of these plans on paper so that they can be formally approved and concurred in, or revised, by the superior of the individual making the plans.

### Conclusion

Budgets, however, it should not be forgotten, have real limitations. The budget is not a panacea for all business ills. Business concerns can only get out of budgets what is put into them. Budgets cannot be any better than the executives or the organization making them and are only intended to offer the executives a method or means of control.

## Employee Traffic Rules

NO one in the Fisk Rubber Company is supposed to use the office or factory elevators at any time who has only one flight of stairs to go up or to come down. This regulation not only saves the elevators for longer distance traffic, but prevents waiting, otherwise employees would often spend a greater time waiting for the elevators to take them up or down than the time the ride would last after it actually started. There is one exception to this rule. Employees going to lunch early are requested to take the elevators instead of passing up the stairs. The reason for this exception is that tramping on the stairs disturbs other clerks who are still working, as their lunch time has not arrived.

These rules are found to cause no inconvenience or hardship, and are quickly accepted by everybody. They act as a traffic cop on the movement of people within a very full building, and secure plenty of elbow room for all.

Two bells announce the quitting hour at noon and again at night for the clerks on each floor of the office building. The first bell is a warning, and rings five minutes before the exact quitting time. The warning bell is a signal to clear desks and put away all working material. No clerk leaves his or her department, however, until the second or final bell sounds.

# Reducing Costs 22% By Motion Study

## Of Manufacturing Operations—Also a 35% Reduction in Shipping Costs

By JOSEPH A. PLACITELLI

[illegible]

THE first installment[1] of this article, showing improvements made in methods and operation by motion study analysis, described some of the studies and the results secured. I do not propose to discuss each of those studies in detail, but will briefly consider the features of the cutting and packing of 10-inch strip shingles which is characteristic of the majority.

Fig. 11 shows a general layout of the equipment used when this work is accomplished by the old method, and will serve as an aid in describing that method and in pointing out symptoms of wasted effort.

The shingles were cut by the machine and deposited on the machine side of the flopper. When a stack of one-half of a square had accumulated there it was revolved ninety degrees about its horizontal axis by operator No. 1. The shingles were then grasped by men 2 and 3, who lifted them about one foot to stand them on edges on the stacking table and to hold them there until men 4 and 5 were ready to grasp and stack them on a bottom board previously placed on the roller conveyor by man 5. In the same manner a second stack was placed on the first half to make a complete square and the stack was pushed down the conveyor, remaining there until one of the tiers was ready to perform the next operation. This tier grasped a

[illegible]

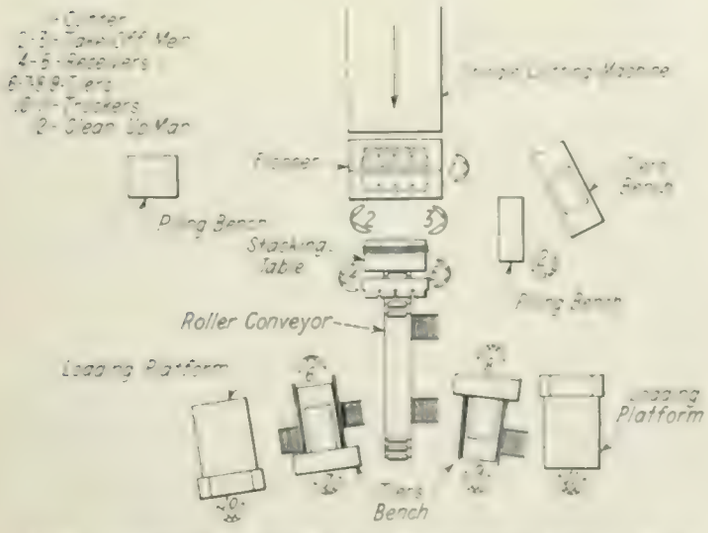



FIG. 11. GENERAL LAYOUT OF THE [illegible] OLD METHOD FOR PACKING STRIP SHINGLES

direction sheet from a supply located near his tying bench, moved to the stack of shingles on the conveyor, inserted the direction sheet between the shingles after lifting up a portion of them, grasped the stack and transported it to his bench. There he completed the tying process by placing a top board on it, looping

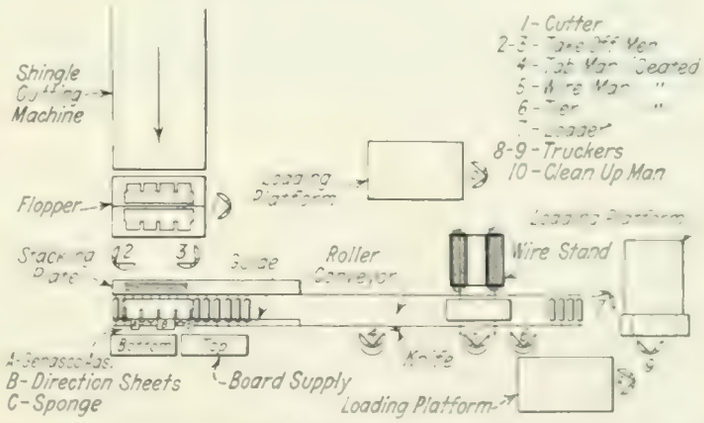



FIG. 12. LAYOUT FOR NEW METHOD FOR PACKING STRIP SHINGLES

a wire around each end of the bundle, tying them permanently with a tying tool and by grasping the finished product weighing 100 pounds and transporting it to the metal skids near by.

With the above description, brief as it is, it seems hardly necessary to point out the facts that the lifting of the shingles by men 2 and 3 can be reduced and possibly avoided, and the additional handling by men 4 and 5, the transportation from conveyor to bench and the "Grasp" and "Release" of the tying tool eliminated. The insertion of direction sheets between the shingles may also be made easier.

A process chart was made, covering this simplified method move for move, and as a result of the analysis a new piece of equipment (Fig. 12) was built, making the execution of the new method possible. The shingles are now stacked on edges and then on to the bottom board, which is located on the new device as near as possible to the elevation of the shingles when in the flopper and is done so without rehandling. Immediately after this, man 2 grasps a Genasco advertisement from pocket *A* and places it on top of the shingles. At the same time man 3 performs a similar operation with a direction sheet taken from container *B*.

The two men return to the flopper and stack the second half of the square on top of the printed matter, as described above. At this time man 3 places a top board on the shingles. Then, man 2 pushes the package down the conveyor with one hand and deposits the bottom board in its place with the other, thus com-

FIG. 13 OLD METHOD OF PACKING STRIP SHINGLES

pleting stacking cycle. The package moves to a position above the wires prepositioned by worker 5, who loops these wires by hand and moves the bundle out of his way, when worker 6 who holds the tying tool in his hands at all times completes the tying operation. The finished bundle is taken off the conveyor by man 7 and deposited on the platform. Worker 4 is not employed during an ordinary run but is used on certain special occasions.

To make the description complete I have selected two views: Fig. 13 is taken from a motion picture film showing the old method and Fig. 14—a view of the present equipment—illustrates the new method.

The fatigue has been reduced to such an extent, especially in the case of men 4, 5 and 6, who are now seated while performing their work, that the effort is not equally distributed among all of them. To overcome this the men rotate functions every hour, thus getting the opportunity to put a different set of muscles into play. This is not only advantageous from the point of view of fatigue and flexibility of organization but also that of maintaining interest. The individual's thorough understanding of the work of each man on his team is undoubtedly the most important factor in team work and this factor is effectively controlled by the rotation of functions.

The unit cost of this work has been reduced 6 per cent, while the wages of the men have increased 2 per cent.

In brief, the results of analyses of the operations which the writer has mentioned and not described are as follows:

The unit cost of cutting 12-in. Latite Squares has been reduced 20 per cent, cutting 16-in. Latite Squares 14 per cent, cutting and packing Extra Heavy Individual Shingles 10 per cent, cutting and packing Extra Heavy Strip Shingles 6 per cent, and cutting and packing 12½-in. Strip Shingles 5 per cent.

The increase in earnings of the men in the above cases varies from one to four per cent. The low figures are due to the fact that the men were earning a good day's pay before the studies were made and aside from that, the new methods enable them to do the same amount of work with less effort.

It may be stated here also that these studies have done much to reduce the labor turnover which, according to our records, has made a decided drop.

### COST OF SHIPPING REDUCED

In case of shipping by freight cars the work may be divided into two major operations, namely, loading the product and bracing it so as to reach its destination undamaged.

When loading, one man of each crew was employed in transferring the product from a conveyor which received it from a chute, to a conveyor leading it to the inside end of the car, doing the work which a curved section might do. (See Fig. 15.) This seemed to be an easy problem in material handling but the nature of our work and the location of the chutes did not permit the use of a common carrier curve. The solution of this problem was effected by the installation of a specially constructed 3-rail, 2-roller curve

FIG. 14 NEW METHOD OF PACKING STRIP SHINGLES

with its outer end elevated to give a 5-in. banking. Both ends are of the same height, making it reversible, for the purpose of loading both ends of the car with the same unit. The chute end of the curve is connected by an 8-ft. section of roller conveyor and the discharge end by a 12-ft. roller conveyor unit made up of three 4-ft. sections capable of being disconnected as the car is loaded. See Fig. 16 showing this conveyor.

FIG. 15 OLD METHOD OF LOADING PRODUCT

One man of each crew transferred packages from conveyor from chute to a conveyor leading to end of the car.

Aside from the elimination of the use of one man from each crew another benefit has been secured, i.e., an increase in elasticity between dropping the product inside the chute on the upper floor and receiving it in the car, which in turn resulted in an increase in tonnage loaded per hour. The men feeding the loaders can now drop the product down the chute at a varying rate of speed, while by the old method, the flow down the chute was governed wholly by the man at the turn. It is obvious then that the new curve enables the crew to do better in spite of the fact that it has been reduced by one man. Our records show this. See Fig. 17 summary of shipping costs.

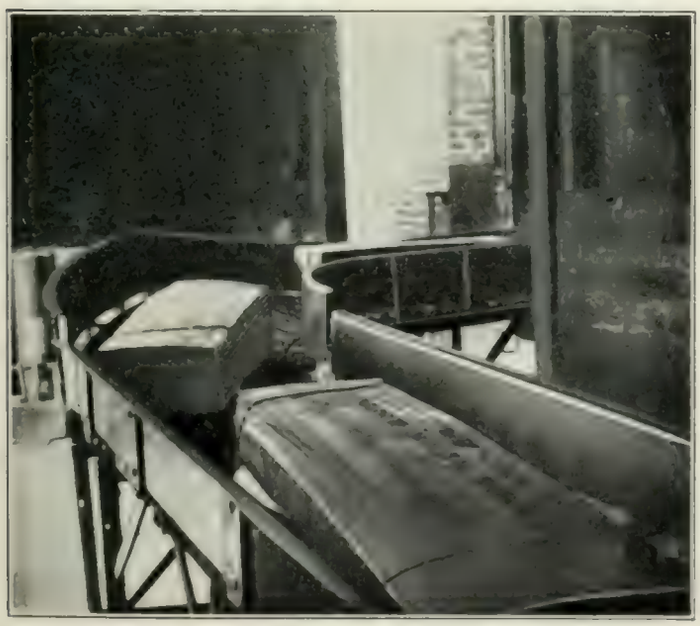


FIG. 16 NEW METHOD OF LOADING PRODUCT

Specially constructed 3-rail, 2-roller conveyor carries packages from chute to car.

The second item considered was the standardization of the method of bracing cars. An analysis of this phase of the work yielded the fact that the car bracer spent more than one-half of his time sawing lumber to make braces and cleats of the desired lengths. With the aim of using ready-cut lumber, thus saving the time of the car bracer which could be well utilized toward increasing the loading ability of the crew, the

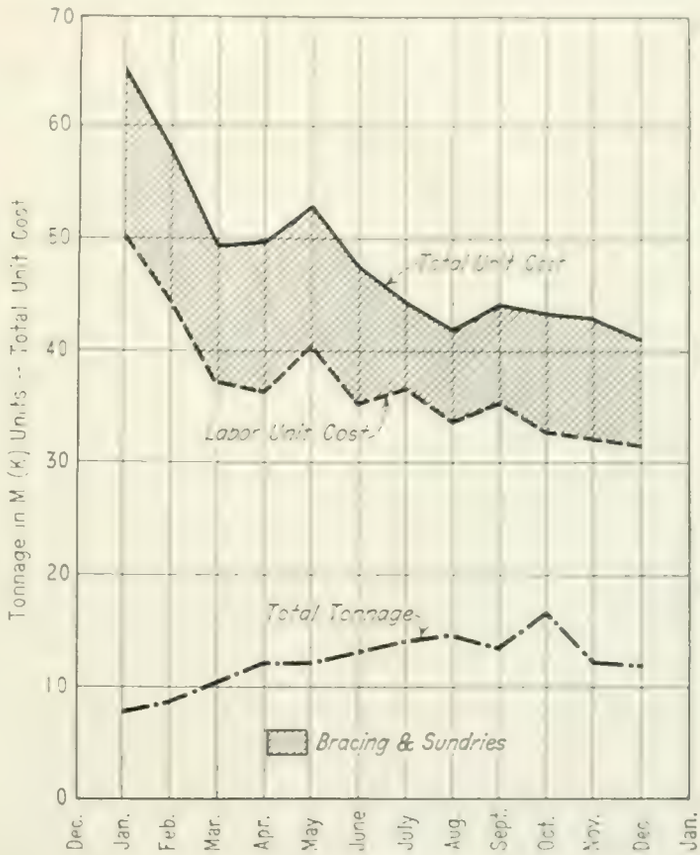



FIG. 17 SHIPPING COST

widths of approximately 60 cars were measured in order to arrive at some common lengths for braces. The standards of lengths were set at 103 in. ± ½ in. and 104 in. ± ½ in. for braces and 36 in. ± 2 in. for cleats.

The possibility of using 2 in. by 4 in. lumber instead of 2 in. by 6 in. was considered and after an investigation of the relative holding abilities of the two sizes it was found that the chief cause of defective bracing was not due to the weakness of the braces nor the improper number of them, but to the way in which they were fastened to the sides of the car. The 2 in. by 4 in. ready-cut braces and cleats have replaced the 2 in. by 6 in. lumber, length for length, thus cutting the consumption of bracing lumber 33 per cent from that point of view alone, while maintaining the former strength and quality standards.

It is, of course, necessary to mention that the ready-cut lumber is more expensive but the additional cost is practically negligible when compared with the saving.

Standing orders have been made effective to facilitate the work of the loading crews in every way possible. The equipment and tools required in various phases of the shipping work have been standardized, and to make sure of their availability at all times and to avoid unnecessary transportation of tools, each crew has been supplied with a steel cabinet in which to keep them and the cabinets located as near as practical to their places of use.

Each of the above items, namely, the standardization of methods, materials and tools, have contributed towards a 35 per cent reduction in the unit cost of shipping. The chart in Fig. 17 shows clearly the effect of standardization after the changes in methods and materials were made.

The results obtained from these studies have had a very desirable effect on the total situation in that the unit costs have been reduced, the work made less fatiguing and the earnings of the men increased—all of which indicate satisfactory solutions of the problems.

# Visible Index for Stock Control

IN the San Francisco office of the Reo Motor Car Company of California about 6000 parts used for repair and replacement are carried. In order to control this stock effectively a special clerk was employed to record all transactions. A short time ago a new system of records was developed by the office

PART NO 1TA11 MAXIMUM 500 MINIMUM 300
DESCRIPTION Valve Guide SELL 40 LIST COST

| Record of Orders Placed | | | | | Record of Orders Placed | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Date | Our No | Factory No. | Ex P P Frt. | Quantity | Date | Our No. | Factory No. | Ex P P Frt. | Quantity |
| 2/20 | E 20 | B X 461 | Fel | 100 | | | | | |

| Monthly Sales | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct. | Nov. | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1924 | | 250 | 175 | | | | | | | | | |
| 192 | | | | | | | | | | | | |
| 192 | | | | | | | | | | | | |

FIG. 1 RECORD OF ORDERS PLACED ON THE FACTORY

force and when placed in operation resulted in a saving of over $1500 in less than a year's time.

Of the 6000 parts carried 5000 are obtained from the Reo factory. To carry records of order for these parts a set of forms like Figs. 1 and 2 were designed. Fig. 1 shows date of each order placed on the factory, branch order number, factory order number, how material was sent, and how much. At the bottom of the card space is provided for recording sales of the part

| Total Received | Date | Record No. | Qty. | Total Delivered | Balance on hand | Total Received | Date | Record No. | Qty. | Total Delivered | Balance on hand |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 2/20 | E 20 | | | 100 | | | | | | |
| | 2/21 | RR461 | 10 | 10 | 90 | | | | | | |
| | 2/22 | Gs 12 | 10 | 20 | 80 | | | | | | |

| Section | Unit | Bin No. | Remarks | Ordered | Shipped | Long |
|---|---|---|---|---|---|---|
| Part No 1TA11 | | | Description Valve Guide | | | |

FIG. 2 RECORD OF PROGRESS OF EACH ORDER

by months for three years. Since the other side is a duplicate of the side shown, there is provided space for showing monthly sales over a six-year period. Obviously this information is of great assistance in determining quantities to be ordered and stocked.

Fig. 2 is used to record progress of each order and is similar to usual stock cards which furnish perpetual inventory figures. It will be noted that identification information such as part number and name, and its location are shown at the bottom of the card. This is because the cards are filed in the visible index files shown in Fig. 3.

To record orders for the 1000 parts which are purchased locally another set of cards was designed. The card to show progress of each order was similar to Fig. 2. The record card gave date of invoice, name of supplier, order number, quantity purchased, unit and unit

FIG. 3 STOCK RECORD CARDS ARE FILED IN VISIBLE INDEX FILES

list price, discount, and unit net price. Space was also provided for a record of past sales.

This is an example of the application of good stock control practices and methods such as have been generally adopted in progressive manufacturing plants. However, such a development is rather uncommon in branch organizations even though the relationship between branch stock and stock at the main plant or source of supply should be very close and at all times in complete control.

Installation of this method of stock control has saved about 75 per cent of the time formerly devoted to recording stock orders and movements.

# Operating and Balance Sheet Ratios

## In the Financial and Industrial Investigation

By ARTHUR ANDERSEN

*Arthur Andersen & Co.*

SURVIVAL under conditions of modern competitive business necessitates a constant vigil over financial relationships and operating results. All businesses strive to obtain competitive advantages in industry and thereby secure an increased return on capital. This very effort tends to narrow the margins of profit and any business which is not alert to competitive progress soon finds itself facing elimination. Sales price levels are seldom within the control of a single business. They are set fundamentally by competition, so that the average concern will realize a reasonable return under average conditions over a period of time. The margin between sales and costs must pay operating expenses and costs of financing, and then yield a fair return on capital invested. The individual business must give its attention to those factors over which it has control, namely, costs of financing, rates of turnover and expenses.

One of the most significant indices to the condition of a business is that afforded through the use of ratios developed from balance sheet and operating statement figures. Some few ratios are commonly used, such as the ratio of net profits to sales, or to net worth, and the ratio of current assets to current liabilities. Other ratios of still greater significance may be only rarely used. The relationships of inventory to sales or cost of sales, of charge sales to receivables, of mortgage debt to assets pledged, of sales to total assets, all have a meaning if it be read.

### Ratios as Indices to Operations

Ratios are valuable indices because they picture relationships uninfluenced by changes in economic values. The economic law of supply and demand is constantly exerting its influence on the general level of prices. In periods of high prices, commodities are high and the purchasing power of money is low. In periods of low prices, commodities are cheap and the purchasing power of money is high. During times of general inflation, profits of business will naturally increase as the buying power of money will be diminished. During times of general deflation, profits will naturally decrease as the buying power of money will be enhanced. An enterprise may realize an increase in profits during a period of rising prices, but may find that there is an actual decrease in ratio or margin on net sales.

The true measure of profits is not the amount of profits realized, but the ratio of those profits to net sales, ratios constituting a measure uninfluenced by changing values. Business should be so conducted that it will yield, as nearly as may be, the same ratio of net profits, all other factors being equal, in periods of inflation and deflation as in normal times, and that ratio should be complementary to a reasonable return on the current value of capital employed. The point to be kept in mind is that the expression of sales values and other current items keeps pace with current economic conditions, but the expression of capital does not. Yet an intelligent study of ratios will aid materially in determining whether a business has kept pace with or perhaps even anticipated changing conditions, especially during times of marked instability, such as were experienced from 1914 to 1921.

### Types of Ratios

Profits are effected by management through three main sources, namely, low financing costs secured through balanced capital structure, rapidity of turnovers and profit margins which include control of expenses. Significant ratios concern the relationships in the same three sources: turnover ratios, operating ratios and balance sheet ratios. The more important ratios in each of these three groups are as follows:

Balance sheet ratios:
- Working capital ratio.
- Net worth to total capital employed.
- Mortgage debt to assets pledged.
- Common and preferred stock equities to net worth to cost of preferred stock financing.
- Leverage secured in business to total earnings.

Turnover ratios:
- Sales to total assets.
- Charge sales to receivables.
- Sales or cost of sales to inventories.
- Sales to plant.
- Net profits to net worth.

Operating ratios:
- Gross profits to sales.
- Selling and general expenses to sales.
- Operating profits to sales.
- Earnings available for financing to annual cost of financing.
- Surplus net profits to sales.

In the analysis of a business, these ratios are applied

[1] Previous articles on "The Industrial and Financial Investigation" by Arthur Andersen appeared in this journal as follows: December 1925, page 325; January 1926, page 17; February 1926, page 113; March 1926, page 201; April 1926, page 277.

further in detail to the various elements of financial condition and operating results to the extent warranted by relevant information desired in each particular case. Each of the typical ratios noted above has significance from an analytical viewpoint.

### Significance of Ratio

Thus the working capital ratio is significant in the light of ability to pay current obligations. This influences credit standing and purchasing power. The company that can purchase at lowest prices has an initial competitive advantage. The ratio of net worth to total capital employed reveals the adequacy of capital investment as compared with borrowed capital and the policy of financing as to proprietary risk. There is a vast difference between a management that finances to acquire temporary borrowed funds and one that finances to have the public furnish most of the capital. The ratio of mortgage debt to assets pledged reflects a measure of the security and assurance that the borrowed capital will be repaid. The ratios of common and preferred stock equities to net worth show the segregation of proprietary risk and are of particular interest in cases of preferred stock financing. The ratio of earnings left in the business to total earnings has embodied in it the elements of conservatism, normal expansion and gradual liquidation of liabilities.

The ratio of sales to total assets embodies the general efficient use of total capital employed. The ratio of charge sales to receivables is the fruit of an efficient or lax credit and collection system. The ratio of sales or cost of sales to inventory is the result of a quick turnover or the carrying of surplus, unbalanced or obsolete stocks. The ratio of sales to plant may show conservative policy or over-expansion. The ratio of net profits to net worth involves the turnover of investment and shows the earning power of a business from the viewpoint of stockholders.

The ratio of gross profits to sales represents the spread between the cost of goods purchased and their selling price or between manufacturing costs and sales. It is the margin of profit between sale price and cost by purchase or manufacture. The ratio of selling and general expenses to sales shows the relative cost of marketing the products and administering the business. It is the proportion of sales expended in selling goods and in administrative conduct of the enterprise. The ratio of operating profits to sales is one of the chief factors in determining whether the business is measuring up to standard in obtaining a fair return on capital. Operating profits are profits before earnings from extraneous sources, cost of financing and income taxes. The ratio of earnings available for financing to annual cost of financing is one measure of the degree of protection to borrowed capital. The ratio of surplus net profits to sales has its significance in the light of rapidity of turnover of net worth to sales, the result of these two factors being the ratio of return on investment.

The working capital ratio is the one most frequently used, being the ratio of current assets to current liabilities, and sometimes known as the "bankers ratio." It reveals the proportion of working capital which is furnished by the business and the proportion which is obtained from creditors, and is thus of prime concern to ordinary trade creditors in the usual course of business and to those making short-time loans.

Factors affecting the working capital ratio are rapidity of turnover of receivables and inventory, amount of credit utilized from trade creditors and the amount of working capital furnished by the capital permanently invested in the business as compared with the amount obtained on short-time loans. Receivables and inventory are major items in the working capital of most enterprises. Conditions which result in favorable or unfavorable turnover of these assets have their effect upon the working capital ratio. Rapidity of turnover of receivables is affected by the terms of credit, business conditions affecting customers' ability to pay and stringency of enforcing collections. Turnover of inventory is influenced by the character and price of the unit of product, its balanced relationship in accordance with production demands, the accumulation of slow moving and obsolete stocks and the general volume of inventory carried in relation to sales.

Both receivables and inventory of a particular business will vary under the influence of changes in these underlying conditions. The working capital ratio is affected directly by the amount of credit utilized from trade creditors. When bills are paid promptly, outstanding accounts payable are less and the ratio is more favorable. When enterprises find it difficult to pay creditors, accounts payable increase and the ratio diminishes. The working capital ratio is affected by the extent to which the necessary working capital is furnished by capital invested in the business. When working capital requirements exceed that furnished by the capital in the business, the excess is ordinarily obtained on short time loans, usually through the medium of bank loans. As such short time loans increase, the working capital ratio diminishes; as they are liquidated, the ratio increases.

### Temporary Financing for Fluctuations

Nearly every business has seasonal fluctuations to a greater or lesser degree. Seasons of production, of consumption, and of intense or lesser activity place varying demands upon the working capital requirements. The normal working capital should be furnished by the invested capital or net worth of a business, but peaks within the year occasioned by conditions or seasonal business may be financed by current bank loans. Fundamentally sound policy requires that current bank loans be virtually paid at least once each year in off-peak periods.

The working capital position and ratio is thus of vital significance and under constant scrutiny by commercial bankers. The ratio is likewise of importance in connection with bond and stock issues, for no business can be conducted successfully without a sound

working capital position.

The range of working capital ratios as between industries depends somewhat upon the characteristics of the industry. In business involving turnover of receivables and inventory, rapidity of turnover and purchase credit terms of the trade are dominant factors having their effect upon the ratio. An industry handling low priced commodities and giving short terms of credit requires less working capital and usually shows a higher ratio than one dealing in higher priced articles and granting longer terms of credit. Ordinarily, a ratio of at least 2 to 1 is required. This ratio has its inception, no doubt, on the theory that the enterprise shall have equally as much at stake as the creditors if not more. Business not involving turnover of receivables and inventory does not require as high a ratio. Operators of office buildings, public utilities and professional lines frequently have ratios, but slightly in excess of 1 to 1. As between enterprises within the same industry, there are no definite characteristic ratios.

### Ratio of Net Worth to Total Capital Employed

The ratio of net worth to total capital employed reveals the relative proportions of invested capital and borrowed capital to the total capital employed in the business. Net worth includes earnings retained in the business, for those constitute a part of invested capital just as much as the original investment. Borrowed capital includes both long term debt and current liabilities. This ratio is a measure which assists in determining the adequacy of invested capital and the security of borrowed capital. Fundamentally, the more capital the borrowing enterprise has at stake, the safer the loans. Ordinarily, except in the case of public utilities and other enterprises whose earnings possess a higher degree of stability, invested capital should exceed borrowed capital. The function of borrowed capital is to finance reasonable requirements, either temporary or over a term of years. When borrowed capital exceeds invested capital, it is assuming the aspect of financing the enterprise, of sharing the element of proprietary risk and must take added precaution as to its security.

The ratio furnishes a basis for determining the policy of financing. Sound and conservative business will borrow capital only to finance reasonable requirements which may be either temporary or over a term of years. It gives borrowed capital every assurance that it will be repaid and does not expect it to assume the least semblance of proprietary risk. The ratio of net worth to total capital employed in such business is usually high. There is another type of management that has limited invested capital and has ambitions in business beyond that warranted by the capital structure. It will borrow capital to the maximum extent possible often without much conscience as to its security. The ratio of net worth to total capital employed under this type of management is usually low and creditors must exercise precaution as to the security of borrowed capital. An enterprise that borrows capital to finance reasonable requirements is ordinarily sound and successful. One that conducts business on maximum borrowed capital often contains the elements of speculation and evades the full responsibility of proprietary risk. The ratio of net worth to total capital employed over a period of time is the key to the financial policy of an enterprise and an index to the responsibility of its management.

### Eliminating Influence of Depreciation

It is always well to ascertain the ratio of cash or properties actually invested in the business to the total actual capital employed, eliminating all appreciation of book values in excess of original cost. The ratio then reveals the actual capital contributed by invested capital as compared with borrowed capital. Irrespective of present appraisal value of properties, the investor and banker are privileged to know how much the enterprise has actually at stake as compared with capital borrowed. It has an influence on the amount which the banker is willing to loan and on the investor in selecting his investments. The ratio on this basis may be supplemented by a ratio based upon present value of properties as substantiated by acceptable appraisals. Consideration may then be given this supplemental ratio as conditions warrant. Fundamentally, the ratio on the cost basis has much the greater significance. This is particularly true when appraisals are not carefully and conservatively used.

This ratio concerns creditors in the order of their security. Unsecured creditors are concerned most, as they are the first to lose in case of liquidation. Secured creditors are primarily concerned with the margin of security pledged, but are also interested in the ratio of net worth to total capital employed from the standpoint of continuance of the enterprise as a going business. Few creditors covet foreclosures. Properties are of greatest value to a business as a going concern. The ratio of net worth to capital employed reveals to the secured creditor a measure of assurance that the enterprise will continue successfully as a going business and that borrowed capital will be repaid without encountering refinancings or foreclosures upon assets pledged. The ratio of a particular secured loan plus equal and underlying liens to total capital employed is likewise a measure of security of the particular secured loan. Junior liens and unsecured creditors would first absorb loss in event of financial difficulties.

### Ratio of Mortgage Debt to Assets Pledged

The ratio of mortgage debt to assets pledged reflects a measure of the security and assurance that the borrowed capital will be repaid. The function of mortgage debt is to furnish permanent capital for a term of years. At maturity it is either paid or refunded. This is in contrast to the function of commercial loans. While current loans are primarily for the purpose of financing and facilitating movement of commodities during peak periods and should be liquidated at least

once each year in off-peak periods, mortgage debt furnishes part of the permanent capital of the business over a period of years. It supplements the capital furnished by investment. In a profitable enterprise where earnings are in excess of the interest rate on funded debt, it automatically increases the return on investment.

The ratio of mortgage debt to assets pledged is usually based on present fair values of the assets mortgaged. In the case of commercial properties, the usual maximum ratio is approximately 50 per cent. Public utility properties are bonded as a rule on the basis of a considerably higher ratio. The permanence and utility of properties have a bearing on the extent to which they may be mortgaged. By basing the ratio on present values, the owner of properties acquired in periods of low prices receives consideration on the same basis as one who has purchased more recently. Likewise, excessive considerations paid for properties are reduced to a safe bondable basis.

### Ratios of Stock Equities to Net Worth

The ratios of common and preferred stock equities to net worth show the segregation of proprietary risk and are of particular concern in cases of preferred stock financing. This applies to any of the various classes of stock, both common and preferred, in accordance with their terms of priority. Stocks assume all proprietary risk. The particular business engaged in is its venture. Net profits or losses from the conduct of business are its reward. In case of reorganization or dissolution, it is the first to lose. The ratio of common stock to net worth and of preferred stock to net worth show the relative proportion of proprietary risk in the light of their respective provisions. The larger the common stock equity, the better the preferred stock. This is the same fundamental principle that underlies the safety of mortgage debt. The larger the junior equity, which loses first in case of loss, the sounder is the particular security.

Preferred stock financing is undertaken under varying conditions. It may be issued when it is not feasible to sell common stock, when it is not desirable to relinquish voting control, in place of mortgage issues with provisions restricting further liens on physical assets or as junior financing to mortgage issues when additional capital is required. When an enterprise is in its infancy with unproven earning power, or when the level of earnings of a business make it difficult to sell additional common stock, preferred stock financing is often resorted to as being more inviting to the conservative investor.

In the normal industrial or commercial enterprise the ratio of preferred stock to net worth should not exceed the ratio of common stock to net worth. When preferred stock equity exceeds common stock equity, the preferred stock is assuming the major proprietary risk and its value is correspondingly weakened. Occasionally one sees preferred stock issued in excess of common stock equity but, in most such instances, it is protected by personal guarantees or deposits.

To realize the significant value of this ratio, it becomes necessary to analyze the net worth. This includes ascertaining how the capital stock was paid for, and a segregation of surplus into its elements of earnings retained in the business and the various forms of capital surplus.

### Importance of Earned Surplus

For purposes of comparative analysis various ratios may be drawn from the balance sheet figures giving the relations of retained earnings to the items of contributive capital, net worth, appreciation surplus, etc. The significance of these ratios is great, when considered from the viewpoint of judging management policies.

The retaining of earnings in business is essential to survival. Competition tends to result in a fair return to the average concern under average conditions over a period of time.

This fair return, which business must normally yield in accordance with its hazards, permits of adoption of the policy of distributing dividends representing normal interest return upon investment and retaining the balance of earnings in the business. Earnings retained in the business, constituting additional capital, are worthy of their hire and must earn a fair return the same as the original investment. Unless material financial reverses are encountered, these retained earnings accumulate with accelerating rapidity over a period of years upon the compound interest principle. Capital invested receives conservative dividends while, at the same time, the value of additional gradually increases. Of the three sources of additional capital—investments, loans and earnings—earnings are most significant. Favorable results attract the other two sources of capital; unfavorable results turn them to other channels.

When earnings are distributed through dividends, they become diffused, just as do the earnings of an individual who fails to conserve his income. A large portion of them are spent and thus lose their productiveness. Retained in the business, they are conserved as productive assets resulting in increased and cheaper production. The tendency of business today as indicated by the increasing number of mergers and consolidations, is toward larger business units. This increases competition and makes survival more and more difficult for the smaller business unit. The small business that does not conserve its earnings cannot hope to survive permanently in competition with the many financial advantages which larger business enjoys. The ratio of earnings retained in business to total earnings over a period of years is the greatest index of the general financial policy of an enterprise, as indicating a dissipating or conservative management and the sincerity with which it seeks to maintain a competitive position in the industry in the effort to insure a stable and relatively permanent existence.

# The First Step in a Market Survey

## Practical Methods to Determine the What, Where, Whom and How of a Manufacturer's Sales Program

By H. L. KEELY

[illegible]

IN the good old days when each manufacturer knocked off long enough to dispose personally of the commodity he produced there was little need of intensive salesmanship. Markets were close at hand, customers well-known and conditions compared with the present day were absurdly simple. The division of labor, increased production in response to a demand for lower costs, and better transportation have tended to force those with something to sell to go far afield, and in many and devious ways to secure the needed orders to keep the factory wheels turning.

Meanwhile the markets have been resolving themselves into separate problems, buying habits are formed, and through the introduction of various types of middle men a very complex situation has arisen. Nor are conditions stationary. What was a logical outlet a decade ago is *passè* today, and so it goes.

One of the first efforts made to co-ordinate the ever-growing functions has been the budget system, which is nothing more or less than a chronological summary of the steps to be followed in order to arrive at a desired objective. As ably expressed by McKinsey:

> As the aim of all business is to dispose of a commodity at a profit the sales plan is the paramount issue of business (the genius of engineering has solved the major problems of production) the sales plan is the key upon which the whole business structure rests for unless the commodity is successfully marketed, the business is bound to fail—the funds necessary for the operation of the business must be derived from the revenue from sales.

Then comes the question of quotas, how much to ask each unit of the selling force to produce for the period. Just as a general must have maps of the scene of the impending battle in order to issue intelligent orders to the forces under his command, so must the sales executive have a picture which will permit his careful planning of the activities to come. It is therefore in order to discuss as a preliminary to laying out the sales budget the reconnaissance of the terrain, selection of the objective and apportionment of the sectors, all before the troops are within striking distance.

Such a course is not only common sense, it is common practice with many of our largest and most successful organizations and the only difference in the procedure that follows from the general run of such efforts is the attempt so to group the information obtained that it can be applied to the existing standards, to set up figures and picture existing conditions so that the weapons of offense and defense can be selected with a minimum of effort from their present natural groupings. The sales executive charged with the responsibility of marketing the commodity, assuming that his estimates of the quotas of sales are the foundation upon which the plans are laid, *must have accurate* answers to the questions that are involved in *all sales effort*. The questions as I prefer to state them are four in number, and quite simple in phrasing. They are:

**Budgetary control of sales must be based on an adequate market survey, which in turn is built up by taking a series of seven research steps. Mr. Keely shows what these are and how they are followed through to get the information for the sales program. His analysis chart of "Your Sales Problem" covers all the essential elements of commodity, market and method, and puts in proper sequence all the sales factors to be studied.**

What is to be sold?
Where is it to be sold?
To whom is it to be sold?
How shall it be sold?

In arriving at the answers to the above it is the purpose of this paper to show the steps necessary to secure the needed information and to call attention to the advisability of making the advertising an integral part of the selling campaign, instead of an after thought to be tacked on just before the drive commences. See Fig. 1.

This method has the added advantage of uncovering obstacles in advance of operations that might cause the best laid plans to fail were they neglected or ignored.

Let us then as a means of careful, constructive investigation, carry through the following operations:

1. Make a study of the commodity and competing articles.
2. Make a survey of the markets to obtain the potential demand and the amount of saturation.
3. Outline a sales policy to conform to the conditions as portrayed by the results of the first and second steps; i.e., whether to use existing channels (jobbers, dealers, etc.), create new channels in the form of our own branch sales offices, or go direct to the consumer by mail, or house to house.
4. Determine the extent and timeliness of the development, or the advisability of opening up the sales areas simultaneously or by districts.
5. Select the media for creating the demand.
6. Determine the amount of the advertising appropriation.
7. Complete the plan and introduce (sell it) to the sales force with quotas for the various territories.

Item 4 will give the amount that *should* be spent for advertising and permit the elimination of such items as cannot be fully developed, as the complete plan will almost always be more far reaching and call for a greater expenditure than past experience has shown can be allowed for advertising.

To take each item as enumerated, we must first be agreed as to what it consists of. The definitions that follow are generalities and are chosen deliberately as descriptive of the conditions portrayed rather than for their dictionary value or accepted meaning.

### STUDY OF THE COMMODITY

A commodity may be said to come under one of the general divisions that follow:

1. Finance.
2. Service.
3. Product.

The sale of many commodities involves two, and possibly all three, of the items; for example: A manufacturer of a patented electrical household specialty markets his machine direct to the consumer on a deferred payment basis, and, at the time of the sale sends an employee to install the machine and instruct the purchaser in its proper use. By reason of the deferred payments he is, in one sense, financing the buyer; the installation comprises the service and the machine itself is the specialty product. This is, however, an isolated case, and the definitions that follow will be perhaps more acceptable for the general run of business, each term being used in the broadest sense.

*Finance.*—Ordinarily the term finance may be construed to embrace insurance, stocks and bonds, promotion, investments, savings, or any function allied to banking or the handling of funds.

*Service.*—Service when marketed may be of several kinds, such as:

Professional.—Doctors, lawyers, and others.

Technical.—Cost accountants, commercial artists, advertising agencies, construction companies, etc.

Public.—Common carriers; light, heat and power companies; telegraph and telephone companies; etc.

Utility.—Clean towel supply companies, caterers, employment agencies, and such trades as carry on a repair or odd job business, as plumbers, electricians, etc.

The fields of professional and technical service overlap. Doctors, dentists and architects are necessarily technical men, but we deem "professional" those occupations that consider it unethical to advertise. Many concerns described as technical are heavy users of advertising space.

The distinction between public and utility services is: Public service is generally a monopoly, while utility service is usually decidedly the opposite, thus presenting an entirely different appeal in selling.

These classifications are general and no definite rules can be laid down as to where any given business may be placed. In passing let us state that the writer knows of a man who passed as an advertising man among his friends, and so he was; he carried a banner proclaiming to all that could read: "The Red Elephant Cafe Is the Best Place to Eat."

*Products.*—Products may be classified as either staple or specialty. In this instance we define staples as such articles usually sold in bulk without a distinguishing trade mark or package which differentiates them from similar articles.

Many such articles formerly classed as staples but now sold in packages, have by reason of their guaranteed purity and the standing of their maker been elevated above the general run of articles in the same class. Such articles as Quaker Oats, Domino Sugar, and Uneeda Biscuit are widely known by their trade names and, by reason of the prestige obtained through a high standard of purity, the convenience of the package to retailer and consumer and by national advertising may be considered as specialties.

In short, any product, patented or otherwise, which has a distinct name, appearance or function from the standpoint of the buyer, may be classed as a specialty.

*Competition.*—A commodity may be said to compete with another commodity when it is used, or offered for use to fulfill a similar function.

In several instances the writer has been assured in all seriousness by manufacturers of specialties that, "they had no competition," it being true in every case that their product had several features protected by patents that could not be incorporated in articles of similar nature made by other manufacturers. And yet there were other devices on the market that served a

similar purpose by different methods and were in everyday use in a wide field, and having the tendency to reduce the demand for the first mentioned device.

It quite frequently happens that the most dangerous competition is one that is indirect, as evidenced by the temporary effect of the radio set upon other products such as talking machines, player pianos and, to a certain extent, theatres and moving picture shows. Now some enterprising talking machine manufacturers are incorporating with their machines a device which permits the use of the horn as a loud speaker in connection with a radio set. This may be cited as an example of turning competition to account.

market: 1. Unlimited; 2. Limited.

Generally speaking in considering markets the potential demand must be taken into account primarily from the standpoint of the life of the utility or the frequency of demand. Such commodities as foodstuffs, clothes and raw material will necessarily be consumed and the demand continue. At the other extreme the demand will usually be satisfied (saturated) by one purchase, a noteworthy example of this type being a coffin.

*Unlimited Market.*—The potential demand and the amount of saturation will assist in determining the limitation of a market and should be the subject of

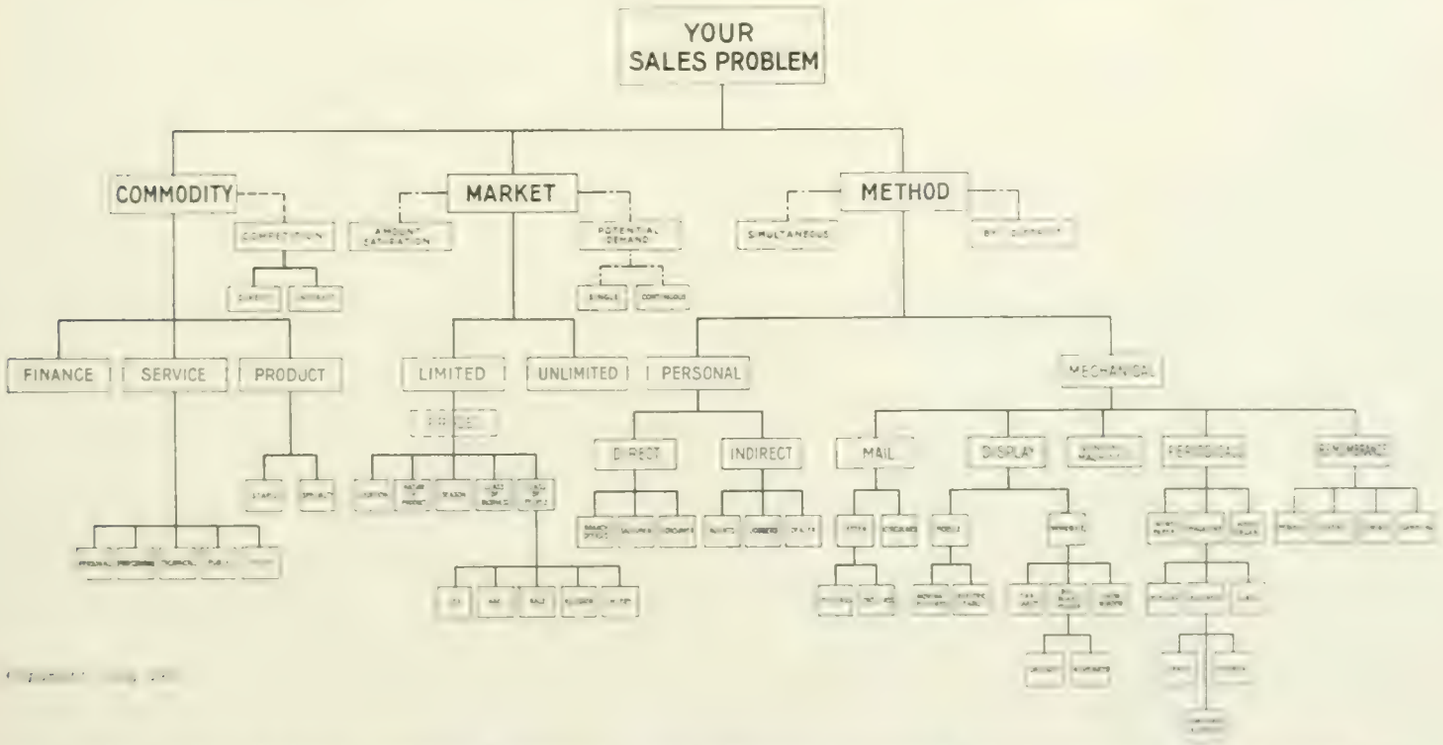



FIG. 1 ANALYSIS OF SALES PROBLEM, COVERING ALL THE ESSENTIAL ELEMENTS OF COMMODITY, MARKET AND METHOD

Another example of dangerous indirect competition is the effect of the increasing popularity of the soft collar upon the laundry and starch industries.

## STUDY OF THE MARKETS

The study of the commodity should also include an outline of the history of the industry to determine the rate of growth, relation to allied industries and indicate general trends for future development. Usually it will suffice to list the principal competitors, their methods, and the hold they have on the markets. In many cases it will be found that conditions exist similar to those in the shaving-soap industry. There are two strong contenders for the dominating place in that market with a third competitor ready to take advantage of any weakness on the part of the first two; following behind are other contestants, some of whom are hard put at times to keep their heads above water.

We have allowed for two general divisions of the

a special section of the investigation under limitations. As we are considering the question from the viewpoint of the sales manager, let us say that unlimited markets exist where the commodity is of sufficient utility to warrant national distribution, although subject to sale only to one sex: such as corsets, lingerie and high-heeled shoes to woman; razors, suspenders and—so far, at least—chewing tobacco to men.

*Limited Market.*—There are five general limitations for markets, and in many cases commodities are affected by all five, price is not considered as a limitation in this analysis as the amount demanded for a commodity will be governed largely by conditions with which this paper does not treat. The limitations are:

1. Location or geographical limitation applies where freight rates and similar conditions will tend to render sales effort of small value. This is particularly true of most staples.

2. The nature of the product may have a tendency to reduce its marketability; an example being electrical household utilities in an area that is not served by a central station, or where the individual homes are not equipped for electric lighting.

3. Seasons plan an important part in many industries and in most cases are conditions which cannot be controlled, although where enterprising retailers have made advance showings of certain types of wearing apparel, it has given them an advantage over their competitors and, to a certain extent, extended the season. A reorganization of the methods of producing and marketing coal is among the opportunities existing for circumvention of seasonal limitation.

4. Class of business bears an important relation to markets. It would be folly to attempt to sell high explosives, dipper dredges, or ship's hardware to a manufacturer of dental instruments, the clothing trade, or the house wife. Yet we encounter magazines having a large number of women readers that carry advertisements featuring material just as inappropriate.

5. Various classes of people have different needs and requirements even in everyday things. No orthodox Jew will consume anything but kosher food, the average Protestant has little use for a rosary, and there are so many classes of people that to enumerate them all would require more space than is available. Sufficient to say that the principal divisions are: sex, age, race, religion, occupation and sport or hobby, each having many modifications for every commodity.

These groupings are arbitrarily made in order to have some starting point from which to work, a rough sorting, so to speak, where, by a process of elimination the factors to be considered in detail are separated for further attention.

The latest census figures will serve as a rough market survey for a commodity such as chewing gum where everyone is a possible consumer, provided he knows the product and has an opportunity to purchase it; in other words, if the product is advertised and distributed in his locality. This statement is subject to limitations of large racial groupings that have not been educated or addicted to the use of chewing gum.

### Market for Fire-Fighting Apparatus

In the case of a special type of fire-fighting apparatus designed to cope with extraordinary hazards, it was first necessary to segregate those industries having high fire risks and analyze each separately. The application of this apparatus to the fertilizer industry will serve as an example.

Investigation showed a total of 704 plants making fertilizer in the United States (the figures are fictitious) these were divided into three distinct groups as follows:

| | |
|---|---|
| Those using phosphate rock as a base | 330 |
| Those using fish scrap as a base | 191 |
| Those using meat and bone scrap as a base | 193 |

A study of the process in each group showed that there was practically no hazard in the phosphate rock group that could not be handled by ordinary methods, and this group was therefore ignored. In warehousing the fish scrap, prior to its entering the process, spontaneous combustion often occurs unless the material is turned frequently and kept well ventilated. In the process of grinding bones it is highly advantageous to eliminate the grease and frequently a solvent is used under pressure. This solvent is generally naphtha. Here is an entirely different hazard from the second group.

To arrive at the potential demand for the second group it was necessary to ascertain the tonnage handled per plant. The engineering department of the fire apparatus company was consulted as to the number of square feet that could be covered by one unit and a simple computation of the number of tons stored per square foot of floor space gave a very close approximation of the possible sales to this type of plant.

In the meat and bone group the tonnage was likewise ascertained, the number of pieces of apparatus necessary to produce this tonage was easily obtained from the manufacturer of such machinery and a good estimate of the possible sales obtained. As this type of fire-fighting apparatus was much more efficient than any competing device, the amount of saturation or number of competing units in service could be treated as negligible. The aim of the company was to replace existing apparatus. The economies effected by reduced insurance premiums, increased storage capacity and elimination of the need of turning the fish scrap made this not so difficult as would appear on first thought. Similar advantages were claimed for the meat and bone scrap plants.

The above procedure was followed throughout all industries having excessive fire hazards and the total possible sales worked out. To develop the entire market at one time was not practicable, so efforts were concentrated on the markets that showed the best promise of speedy returns. Many other details were of course indicated, and this survey served the double purpose of establishing quota and furnishing the advertising manager with a knowledge of the proper appeal to make for each industry.

### Quotas from Potential Demand

In the establishing of quotas, the sales manager has before him the total potential demand and in conference with his district managers and with the individual salesman the percentage of the total desired as a task is easily arrived at, and the sales force does not feel that they are imposed upon by being asked to perform a seemingly impossible task, as is often the case when quotas are arbitrarily assigned without supporting figures of probabilities.

Each item or group of items in the commodity list that serve different functions or markets must be analyzed separately and treated as units, arriving at conclusions independently of other groups or items.

# Keeping Research on a Business Basis

## General Motors Corporation Operates Its Great Laboratories on Control and Results Policy

By GEORGE E. HAGEMANN

*Associate Editor*, MANUFACTURING INDUSTRIES

RESEARCH has properly come to be appreciated as a fundamental necessity in most large manufacturing organizations. It is an expense which often for a long time makes no financial returns. Finally it may develop new methods, materials, designs or products which pay handsome profits on the sums spent in discovering them.

In the meantime, research may point out the inadvisability of adopting numerous suggestions which seem to hold out promises of brilliant success. Not every plan or device which appears desirable and perfectly feasible becomes a commercial possibility. Careful investigations point out the flaws which make it worthless for development and application. Heavy losses due to investments in equipment and changes to wrong methods are thus many times avoided, and research pays its way in such cases by negative instead of positive results.

The General Motors Corporation Research Laboratories at Detroit

The automobile industry offers one of the most striking evidences of the industrial and social benefits of research ever presented in the manufacturing field. Within about a quarter of a century it has risen from almost last to first place in value of output, and ranks second only to cotton in value of American exports. While the dollar will today buy on the average only $0.63 worth of goods on the 1913 basis, it will purchase $1.10 worth of its 1913 value in automotive products. One has only to review the research work of the Society of Automotive Engineers and of individual companies in the automobile field to find the basic reason for this fortunate reversal of the recent general economic trend.

The General Motors Corporation has been a leader in the development of research work. Its laboratory at Dayton, Ohio, was long the headquarters of the company's applied technical and scientific investigations into all items entering into the make-up of an automobile. During the last year this work has been transferred to a large building in Detroit (see Fig. 1), adjoining the general office building of the company, and to shop buildings a few blocks away, where engine tests, paint and varnish research, and similar work are carried on.

A complete chemical research laboratory is located in the main building. Physics, one of the fundamental engineering sciences, has a special department devoted to it, where methods and instruments for measuring, weighing, calculating and testing automotive devices are worked out, constructed and put into service. The electrical division handles all research in ignition, batteries, lights and other electrical parts of a car.

A thoroughly organized department for physical testing is supplied with tension, compression, torsion and other machines of the best types for this branch of research. A sound-proof room has been built to carry on work to reduce noise and vibration in cars. A

complete foundry, forge shop and machine shop is located in one of the buildings, for the making and assembling of automobile engines and other parts of cars for experimental purposes, and for all sorts of metal equipment needed for research purposes.

To improve the appearance of cars and protect them from attacks of sun and water, the preservative coating of varnish must be light-, heat- and damp-resisting. Style and beauty are strong sales factors and both are either made or marred by the finish used. Hence a special department for research in paints, varnishes and other coatings is maintained. A photometry division conducts exhaustive investigations into headlights, reflectors, glass and lamps. Wind resistance of cars, air cooling of radiators, elimination of dust from air going into the engine, and other studies are carried on continually.

Testing of engines is a very important part of the work of the laboratory. The engine and its accessories are the life of the car, and upon their continued improvement rests the future growth of the entire industry. Hence no phase of engine development is lost sight of. A dynamometer room is in constant service to measure the horsepower, fuel consumption, cooling water and other factors of engine operation on about 15 units at a time. Carburetors are designed, constructed, tested and improved by another section. A fuels division carries on research into the development of better mixtures and the possible application of new fuel combinations to obtain greater economy. A refrigerated room has been fitted up to test cars under conditions met in severe winter weather. Special chassis test dynamometers duplicate road conditions for the determination of data as to behavior of cars in actual use.

The research department organization is of great importance. The General Motors plan is to have a director of research with whom are associated two assistants, one in charge of technical activities and one to supervise the business activities of the laboratories. Research work is divided into 10 distinct divisions, each in charge of a department head who is responsible for the detailed administration of his particular division and the correlating of its work with that of other departments. The main divisions thus organized are: Mechanical Engineering; Electrical Engineering; Chemical; Metallurgical; Fuel; Mass Transportation; Dynamics—engine tests and thermodynamics; Engineering Tests—road tests; Special Problems—special assignments; Technical Data.

Certain functions classify under definite divisions and when problems in these fields arise they are automatically assigned to the man on these regular lines of work. Much of the research activity, however, centers about individual problems and must be specially assigned to men in the division having work of the particular nature in charge. Hence the actual organization chart changes slightly as old jobs are finished and new ones are taken on.

FIG. 2 INTERIOR VIEW OF ONE SECTION OF THE CHEMICAL LABORATORY

Research problems are referred to the laboratories from one of three sources: Engineering departments of the various General Motors units, such as Cadillac, Buick, Chevrolet, etc.; the New Devices Committee;

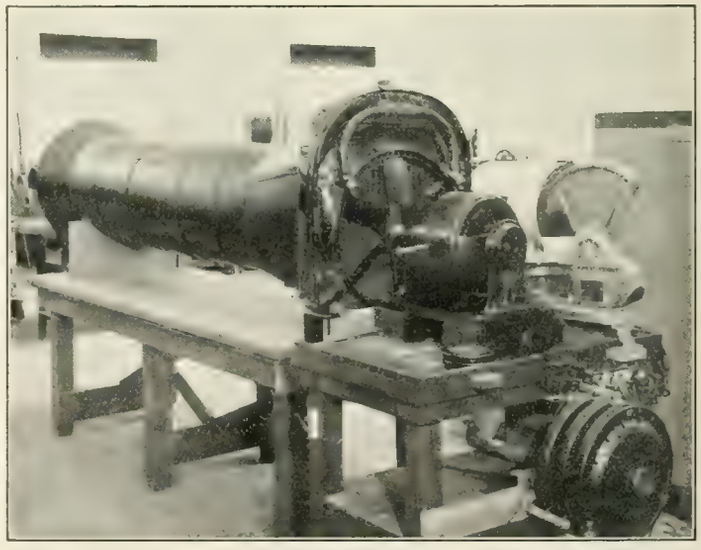


FIG. 3 TEST OF RADIATOR FAN BY WIND TUNNEL

and the Research Laboratory Committee consisting of the director and his two chief assistants.

The engineering department of each company comprising the General Motors Corporation conducts development and experimental work on its own make of car, and designs and tests new models and new de-

vices. Each unit also specifies and inspects its own materials and in other ways conducts activities which are closely related to research. But for many items an exhaustive search, intensive study and a wide range of experimenting and testing are advisable. Expert knowledge and exceptional technical and scientific skill are often requisite. Work of this kind can be carried on much more successfully and cheaply by a fully equipped laboratory, able to build special testing devices, if necessary, than by the experimental departments of the individual plants, which cannot economically provide for such a comprehensive range of research. Hence the various engineering departments call upon the laboratories for work of this kind.

New methods or devices are often conceived by the

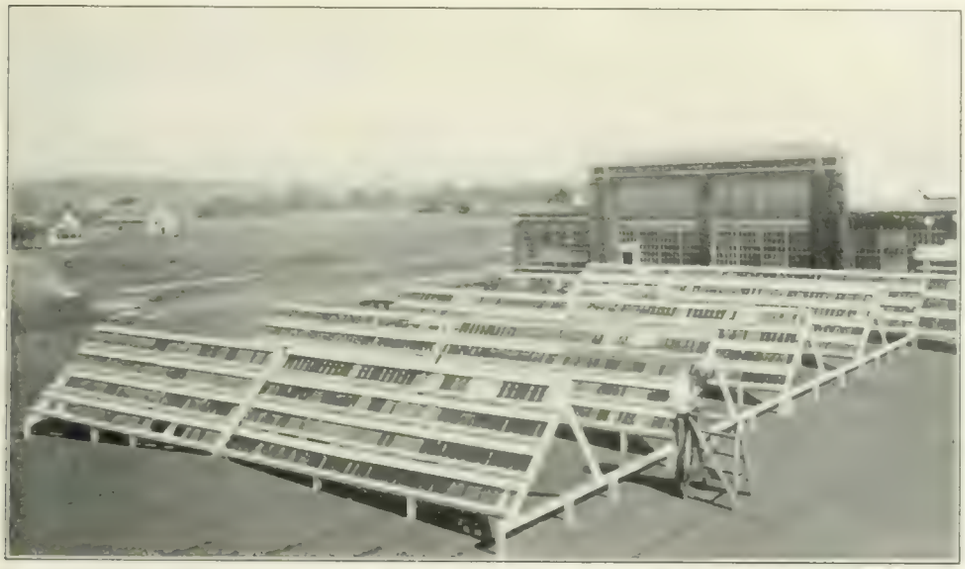


FIG. 4 WEATHER TESTS OF PAINTS AND VARNISH

Research Laboratories Committee. The possibilities of these suggestions are analyzed and if they hold forth good promise they are put through the usual rigorous scrutiny and later into project form.

A General Technical Committee consisting of the chief engineers of all the General Motors companies and the director of the laboratories reviews all proposals from any source which the first investigation shows to have merit. If this committee decides that the idea is useful and the means suggested appear feasible, the proposition is referred to a definite division of the laboratories and a preliminary survey is authorized.

This assignment puts the matter in the hands of the department concerned. Their task, after acquainting themselves fully with the details of the proposal, is to make a preliminary study of the proposal and report on its desirability. If the report is unfavorable the matter usually is dropped. If it is favorable, the Research Laboratories Committee gives approval to the project and a man in the department concerned is definitely assigned to make a more detailed preliminary survey. This survey consists of a thorough search of all printed literature on the subject.

The company maintains an extensive library containing all the leading technical and scientific books in the automotive and related industries, and files of the leading industrial publications. These are all carefully indexed by an experienced librarian.

Besides this, the Engineering Societies Library in New York, the patents library of the National Automobile Chamber of Commerce, and other sources of information are drawn upon when necessary. No pains are spared to make this preliminary survey comprehensive and thorough, and a complete bibliography on the subject is worked up.

The investigator reports his findings to his department head who refers them to the Research Laboratories Committee. The study is now reviewed to see if it is worth further following up. If not, it is definitely abandoned. If so, it goes on the regular schedule.

Reports on abandoned projects are not thrown away, but are as carefully recorded, indexed and filed as those on worth while ideas. Some day the rejected proposal is sure to bob up again, either in its original form or with some modification. Moreover, part of the idea may pair off with part of another plan at some future date, and the combination may be useful. A heavy expense is avoided at the slight cost of filing records of rejected proposals, because this procedure eliminates duplication of thousands of hours of work as future projects come up.

An acceptable project receives an appropriation for its development according to the following plan. A full report on the condition of every project is made four times a year—January, April, July and October—and an estimate is made of the percentage of each which remains to be accomplished. The past and probable future cost of each is listed, and each is reviewed to determine whether it still seems worth while. On the basis of this analysis a quarterly appropriation, based on the relative merits of the case, is made to each project which it is decided to continue. A sum is set aside for general miscellaneous purposes. Any project approved and started between quarters is financed until the end of the quarter by the Research Laboratories Committee out of this general fund. When the quarter is ended the project comes up with all others in the regular way.

In all the work of the Research Laboratories close contact is maintained with the engineering and production departments of the various General Motors units. In this way every project undertaken is sure to be developed along the most practical lines for its immediate application to automobile construction.

When the results of a research project have been accomplished, a comprehensive report of the work is

prepared, edited, indexed and filed in the Technical Data Section. Such reports, or important parts of them, are constantly consulted in future problems.

The device or method developed is delivered to the proper group. If, for the technical division of one of the unit companies it is turned over to the engineering department of that concern. If it must undergo thorough service tests it probably is assigned to the Proving Grounds Division for this purpose. If ready to go on the market, the customer becomes the dominant final authority.

### IMPORTANCE OF PERSONNEL

The most important factor in research work is the personnel. Where manufacturing processes are concerned extensive use can be made of machinery and mechanical handling devices, whose operations are definite and known.

But in research the results rest entirely with the men. Some standard equipment and commercial devices are used but they are often hand-operated. Every job is special and even the uniform procedure employed in normal inspection work becomes individual because an isolated result is looked for instead of uniformity. At every turn the condition is met that developments and discoveries are absolutely dependent upon the human element. This situation raises many perplexing problems.

In the first place, there is a question of initiative. This quality is basic in a research engineer or scientist, otherwise he could never qualify for the duties of such a position. But initiative may lead him into channels of intense interest to him personally, but of remote, if any, use to the industry he serves. On the other hand, rigorous restrictions against any methods or objectives other than those prescribed by his department head may become so irksome to him that he cannot accomplish any results. The General Motors Laboratories have solved this problem in the research field in the wise manner that it has been handled in executive tasks in other fields by men gifted with qualities of genuine leadership. They aim to impose only those restrictions commensurate with good organization and co-operative effort, leaving as much as possible to the man himself, and letting him take his little "fling" by an occasional job on pure research, as distinguished from applied, when a good opportunity opens up.

Another very difficult problem faced by the Research Laboratories is the selection of the task in each case. Where meritorious suggestions and ideas are presented, they must be carefully weighed as to their economic and commercial value. Obviously, most of the research undertaken must bear directly upon application to the automobile. Will the new idea add more service life to a car, will it aid in preventing breakdowns or failures of some piece of equipment, will it enhance the style and beauty of the automobile?

The two main objectives of research in an individual organization are to increase corporate earnings directly by reducing costs, or indirectly by enabling reduced selling prices to be set which will increase sales; and to bring about those social benefits which come to a nation whose products occupy a place of leadership in the world's commerce.

Expressed in detailed terms, the objects of research, as conducted by the General Motors and other large concerns, are:[1]

1. Reduced cost of production.
2. Reduced operating costs to users.
3. Increased utility of product.
4. Increased sales appeal.
5. To produce new business.
6. To develop new technical information contributory to some other project contemplated or under way.

Rubber fan belts were thus analyzed and finally adopted by the company with these estimated results:

| | |
|---|---|
| Reduced cost of production | 10 per cent |
| Reduced operating costs to users | 35 " " |
| Increased utility of product | 50 " " |
| Data of value in other projects | 10 " " |

When a project has been started its objective must be kept definitely in mind. The methods of reaching this objective usually call for expert skill and knowledge. New ways of arriving at results must be thought out and new equipment and apparatus must often be constructed. The research inquirer must be constantly on the alert to detect deviations from the course mapped out—occurrences which may spoil all the previous work done on the task. More than this, he should be alive to the appearance of some strange and unexpected factors which may yield a valuable result entirely foreign to the original objective.

At various stages the progress of the idea must be evaluated. Theories and principles formulated must be given practical form and subjected to many tests to determine whether the result achieved will stand up under the severe demands it will have to satisfy when commercially applied.

Much of the work carried on can be usefully applied as soon as it is finished. While the general principles of automotive design seem to be well-established, thorough research into the various elements of construction is constantly developing improvements that extend the social and economic value of the car and widen its applications and sales possibilities. Many of the projects conducted cannot be used at present because the time is not ripe for their introduction. No industry can successfully move faster than the demands of the public. But neither can any industry long thrive which fails to have ready what the public wants in time to supply the need at its early stages.

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[1] From address by F. O. Clements, Technical Director, General Motors Research Laboratories, at the December 1925 Annual Convention of the American Association for the Advancement of Science, and appearing in *Scientific Monthly*, April 1926.

# Fatigue From a New Point of View

## Physiological Maintenance of the Human Machine in Industry

By HOWARD W. HAGGARD, M. D.

*Department of Applied Physiology, Sheffield Scientific School, Yale University*

MAN is a prime mover and all the problems concerning his physical activities are engineering problems. Physiology is thus a form of engineering. It applies to the study of the human machine the same principles that the mechanical engineer applies to inanimate machinery. The basic principles of engineering and physiology are identical. The engineer says: "A pound of carbon as coal, burned under the boiler, yields its energy exactly as work and heat, and the carbon is recoverable quantitatively from the flue gases." The physiologist says: "A pound of carbon as sugar, burned in a man, yields its energy exactly as work and heat, and the carbon is recoverable quantitatively from the air exhaled." Moreover, the comparison does not stop with the engineering aspect but even carries into the economic. The food with which the employee stokes his engine, is burned at the employer's expense. His fuel is as important to the employer as the coal burned under the boilers of the factory.

**Management is vitally concerned with the workers' capability of doing work. For an individual this may vary from zero to full perfection. Dr. Haggard shows how this capability is affected by the body, and declares that physiology provides information of the greatest value to industrial managers. He suggests that foremen be educated so that they can intelligently concern themselves with the defects of those under their charge.**

The human machine is an essential part of industry, and physiology is the study of that machine. Nevertheless the vast engineering resources of physiology have not been drafted to the use of industry and to the study of the normal man in the environment of the factory. Rather, physiology has applied its material to medicine, and has covered its findings with the nomenclature of that field. Physiology possesses much material of great use to industry but the difficulty lies in the application of this material. There is an adage in physiology, worded in the terms of its kindred science, which says: "An experiment cannot be taken bleeding from the laboratory to the bedside." I may add that neither can it be taken to the factory; nor should the factory be the laboratory.

To know and to apply are vastly different things. The work of intermediation and application is often as important as the original research. The physician has served as the link between the physiologist and the sick man. But most men in industry are not sick; and while the problem of their normal activity is still a matter of physiology, the physician is no longer a connecting link. Who then is to be the intermediary between the resources of physiology and the normal man in industry? Such an intermediary must be a man who has extended his engineering knowledge to include not only inanimate machinery but animate machinery as well. When the engineer essays physiology without the prerequisite training his findings are often ludicrous to the physiologist; the reverse is also probably true.

It is my purpose here merely to present a point of view—a physiological point of view. Every problem which concerns the performance of a man has a physiological point of view. I have chosen the problem of fatigue as an illustration.

The term "fatigue" is a sort of miscellaneous file, into which are cast a number of conditions all having a common symptom, a diminished capacity to do work occurring as a result of work. The habit of classifying conditions according to their ultimate manifestation is a common one. To many, all diseases in which there occurs a rise of temperature are "fevers." Progress in treating and preventing these diseases, however, is made only when the "fevers" are classified on some other basis, as for example are malaria and typhoid. Classification and differentiation are the first steps in progress. Some day when fatigue has been studied from the physiological aspect we may find there are as many different forms of fatigue as there are "fevers."

Fatigue in its better known form is primarily a phenomenon of the muscles, and in my discussion I shall use that type, although what I have to say applies equally to fatigue under any other conception, or from the exercise of any system other than the muscles.

Fatigue is the product of two factors: One is the work done; the other is the man's susceptibility to fatigue. Studies in industry have laid emphasis upon the factor of work done. It is true that with a uniform susceptibility to fatigue, or *fatiguability*, the product fatigue must rise as the intensity or the dura-

tion of the work is increased. Motion studies, systematization, rest periods, and the like, by diminishing unnecessary work or limiting the duration have acted upon the product through the factor of work done.

But what about the factor of susceptibility? That, in fatigue, is the physiological viewpoint. From common observation we know that some men are more susceptible to fatigue than others. We also know that a man's susceptibility to fatigue varies from day to day. A striking example of the latter point is seen in disease; the outstanding feature of convalescence is the great susceptibility to fatigue. A sick man gets tired trying to lift his head or his hand; he gets fatigued from trying to read or even listening to someone talk. From that high point of fatiguability the factor decreases to a minimum for the man when he is in the best physical state, is working under an optimum of environmental conditions, and performs a task suited to his capability.

Susceptibility to fatigue is determined by four factors: The man's constitution, the perfection of his working order, the environment under which he works, and the nature of his task.

I shall discuss first the nature of the task in relation to fatigue, for this factor bears the closest relation to the approach ordinarily made to the problem of fatigue.

Fatigue in any set of muscles does not bear a proportionate relation to the power expended by those muscles. Rather the fatigue appears with disproportionate rapidity as the intensity of the work rises. In other words doubling the task more than cuts in half the time at which fatigue appears. A man can walk at the rate of three miles per hour for four hours, let us say, before the muscles of his legs become fatigued. But he cannot go at the rate of six miles an hour for two hours before fatigue appears, nor can he go at the rate of 12 miles per hour for one hour. A mile runner goes at approximately the last speed, and even the trained man is exhausted at the end of five minutes.

The disproportionate shortening of the work as the intensity of the work rises is a principle which I wish to emphasize. It is a principle which is closely correlated with susceptibility to fatigue.

The muscles of each man have the capability of expending energy at some maximum rate which is individual to the man and is determined by his constitution, his physical state, and his environment. The task sustained by the man in his occupation calls for the expenditure of some percentage of this maximum capability. As the percentage rises the time in which fatigue appears is more than proportionately shortened.

### Fatigue in Relation to Capacity for Work

The capabilities of two men may vary widely. A similar task performed by each, therefore, utilizes a different percentage of their respective capabilities, and the length of time the task can be performed before fatigue appears shows a greater difference than the comparison their capabilities would indicate. For the sake of illustration, let us say that one man has a capability of 100 in any units which might express such a function, and that his fellow-worker has on the same scale a capability of 50. The task involved is the same for each man, and uses 10 per cent of the capability of the first man, and 20 per cent of that of the second man. Although the second's capability is half as great as that of the first, his fatigue will appear in much less than half the time.

By the same reasoning: If an individual's capability is varied, his susceptibility to fatigue is more than proportionately varied in the same direction as his change in capability. A man's capability varies with the state of his health, age, and environment. His susceptibility to fatigue follows these changes through an amplified range.

Fatigue does not bear an exact relation to the total energy expended by the body as a whole. In performing the same tasks, greater fatigue occurs through utilization of a small number of muscles than through the utilization of a large number of muscles, even though the utilization of the greater number may cause an actual increase in the total energy expended. The smaller the number of muscles used in performing any task, the greater must be the percentage utilization of the capability of those muscles. As the percentage utilization of the capability rises, the fatigue is more than proportionately hastened. From the viewpoint of fatigue the most economical way to perform a task is to spread the effort over as great as possible a number of muscles so that each muscle is worked at a low percentage of its capability.

### Fatigue Not Dependent on Energy Expended

The feeling of fatigue or tiredness follows more closely the percentage utilization of any group of muscles than it does the total energy expended by the body. Thus a man may feel fatigued from the intensive utilization of a small group of muscles which when expended even to their maximum cause but a small increase in the total energy expenditures of the body. Thus standing erect or holding the body in a strained position causes more fatigue than would walking slowly, although the energy expended in walking is three or four times as great as in standing. In standing erect or holding the body in a cramped position a small group of muscles are worked intensively and at a high mechanical disadvantage; in walking a large group of muscles are worked moderately.

Muscular efficiency (total thermal efficiency) is another aspect of work which bears upon fatigue. As the muscular efficiency for any task diminishes more energy is expended by the muscles and the task is performed at a greater per cent utilization of the capability of the muscle. The relation between the per cent utilization and fatigue has been pointed out above. The total thermal efficiency obtained by man in many of the common acts such as walking, running

or rowing, has been determined and ranges from 15 to 30 per cent. But it does not necessarily follow that such efficiencies are obtained in many of the acts performed in industry.

The muscles themselves probably have a fairly uniform efficiency for any task to which they are accustomed, but the efficiency of the isolated muscles is not necessarily the efficiency which is attained in the task. The work of the muscles is not applied directly but is transmitted through a lever system. The mechanism of this lever system plays a large part in determining the efficiency with which the muscle delivers its power; a variable per cent of the work of the muscle may be lost through the mechanical disadvantages of the transmission. The manner adopted by the man in performing a task may thus have a profound influence on development of fatigue.

### Muscles Act Through Mechanical System

In working the muscles exert a force to bring closer together the structures to which their two ends are attached. The pull of the muscle is not applied directly to the task which they are expected to perform but is transmitted through a system of levers made up of the bones and joints. A muscle works at its maximum efficiency when it is extended to its greatest length, and as it shortens from that point its efficiency falls off. The application of power by the biceps is an example.

The biceps is attached at its upper end near the shoulder and the attachment serves as its fixed point. The lower end of the biceps is attached to the bones of the forearm, some two inches below the elbow joint. This lever of the third class has its least mechanical efficiency when the arm is fully extended and its greatest mechanical advantage when the forearm is at a right angle with the upper arm. The pull of the biceps is the greatest when the arm is fully extended, and much less at the point of maximum mechanical efficiency of the lever system. The diminishing pull of the biceps, however, is compensated by the rising mechanical efficiency of the lever system so that for an application of force made through the hand, the muscle has a practically uniform pull and efficiency from complete extension to one-half flexion. From the point of mid-flexion, however, the efficiency both of the lever system and the muscle falls off rapidly. Most of the other muscles of the body do not have this fortunate compensation of the diminishing muscular efficiency by the rising mechanical efficiency of the transmitting system.

### Fuel Burned in Doing Muscular Work

A final aspect of the work done in relation to fatigue concerns the fuel burned in doing the work. The muscles are in the terms of engineering both coal burners and oil burners; the muscles will work when supplied by the blood with either sugar or fat. By preference, however, the work is done on a mixture of about two-thirds fat and one-third sugar. Moreover, the efficiency of the muscles is considerably higher when they are supplied with some sugar than when they are forced to use fat alone. The supply of fat in the body is large; the supply of sugar is small and must be frequently replenished through ingestion of carbohydrates.

### Sugar or Oil Burners

Most men are strictly oil burners when they get up in the morning, for during the night they have used up their supply of sugar. The sugar in the morning cup of coffee or on the cereal supplies available sugar within a few minutes of its ingestion, the carbohydrate of the toast or bread follows more slowly. Until the supply of sugar is again exhausted, the muscular efficiency is higher than it was before breakfast. From the physiological side one is inclined to view the late morning and late afternoon falling off in factory output with some speculation as to the part in it played by a reversion of the body to oil burning and diminished efficiency. A cup of coffee or tea with sugar, or chocolated milk, supplied at the employers' expense might in some cases be a profitable investment.

The moderate exertion of a large group of muscles may cause a more rapid recovery from fatigue than would complete rest. The recovery from fatigue is closely correlated with the volume of the circulation supplied to the exercised muscles. By moderately exercising a large group of muscles the circulation to all of the muscles is increased and the tired muscles receive a greater supply of blood than they would in bodily rest. From a physiological point some form of callisthenics should give better rest to workers who utilize a small group of muscles than would sitting or even lying down.

### Fatigue Recovery

The volume of blood circulated to the muscles not only influences recovery from fatigue but also the period which elapses before fatigue occurs. A striking example of the latter fact is seen in men in whom the arteries of the legs have hardened and become partially occluded. The flow of blood to the muscles of their legs is diminished. They are susceptible to fatigue to such an extent that in walking they are forced to stop and rest every few blocks.

The volume of blood which the heart of a normal man pumps to his tissues each minute shows a distinct variation with the position of the body. When he is sitting down his circulation is approximately 25 per cent less than when he is lying down; when he stands his circulation falls off an additional 25 per cent. The heart of an average sized man at rest pumps about 9 liters of blood per minute when he is lying down, 7 when sitting, and 5 when standing. Obviously rest in a prone position brings a more rapid recovery from fatigue than does either sitting or standing. Likewise for tasks which entail the activity of a small group of muscles, a better supply of blood is furnished the muscles while the man is sitting than when he is

standing. The exertion of a large group of muscles obliterates the influence of position upon the circulation. In walking moderately the volume of blood pumped is about double that of rest in the prone position.

Above I have used the rather indefinite term "capability" as the amount of energy which a man can make available for any task. Although capability appears as a function of the muscles or any other system performing a task, it is nevertheless an expression of the body as a whole.

The muscles are simply an organ of the body, as is the heart, lungs or brain. The capability of the muscles is no greater than the capability of the least capable of the organs of the body. In their performance the muscles suggest in many ways the production in a factory where the article manufactured must pass through each department. The rate of production is no greater than that of the slowest department.

### Factors in Rate of Human Production

The factors which influence the rate of production in each department of the human factory are constitution, environment, and perfecting of working order.

Constitution is a man's build or construction. Men are born with constitutions, just as machines or factories are given them by the material and perfection of their construction and organization. The initial endowment of the constitution is a result of heredity. But this constitution is only a start; the initial endowment of a man does not indicate what constitution he will have when he reaches any subsequent age. His value to himself as a used machine depends upon the care he has taken of his constitution.

### Influence of Environment on Capability

Environment exerts its influence upon capability by distracting the activity of some department of the human factory and thus limiting the production of the factory as a whole. An organ actively attending to its own particular function imposes a limitation upon the activity of the muscles and upon every other system in the body. For example, when the digestive tract is engaged with a heavy meal it usurps blood which otherwise might be used by the muscles. The activity of the brain imposes a similar and even more marked limitation. The factors which engage the activity of the organs of the body often arise from external causes. Thus carbon monoxide inhaled from exhaust or producer gas combines with the blood and imposes a limitation to the use of that transporting fluid. The great increase in susceptibility to fatigue is the outstanding feature of mild carbon monoxide poisoning.

Lack of cooling power of the air furnishes the best example of the influence of an environment in the limitation of capability and the production of fatigue. A hot environment and one in which the air lacks cooling power may be quite different things physiologically. The heat production in the body is dissipated from the skin but it is not brought to the skin by simple conduction from the underlying tissue. The heat to be dissipated is brought to the skin by the circulating blood. The skin, like the muscles, is an organ of the body; the activity of the skin in dissipating heat limits and depresses the activity of all the other functions of the body.

### Influence of Air Cooling on Output

Nearly 50 years ago the statement was made that: "Every hindrance to free heat loss either reduces bodily exertion or causes it to be done under a feeling of oppression and a burden of fatigue." One of the most recent studies of ventilation showed a falling off of output of 28 per cent as a result of a rise of 7 degrees F. in the air; in another study the output fell 50 per cent when the dry kata reading was reduced from 6 to 1. (The kata thermometer records the cooling power of the air.) Probably few employers realize the cost to them of a drop of unevaporated and therefore wasted sweat.

Imperfection of working order is one of the factors which limits capability. A man who has an organic disease of his heart may have excellent muscles in his legs, but when he tries to walk upstairs his legs give way. They have not the capability to perform the task and become fatigued. Their low capability does not arise from any defect of the muscle, but comes from a failure of the circulation to compensate for their activity by a suitable supply of blood. In choosing an organic lesion of the heart to illustrate my point, I have taken an extreme condition. But from this extreme to complete perfection of working order the sequence of capability rises without a break. Extreme conditions do not concern industry for they are obvious. The minor defects of working order do concern indusrty, however, for the aggregate of each man's minor defects imposes a limitation to his capability.

### Education Can Help to Eliminate Minor Defects

The greatest factor in eliminating these minor defects both organic and functional, is through the education of the man or of his immediate superior. On such subjects it is difficult to obtain a suitable approach from the medical profession; men often put more faith in lay advice than they do in the advice of a physician. This last is particularly true for the minor defects of bodily operation. There is a tremendous amount of missionary work to be done in telling men how the machine with which they are endowed operates. Any man who is capable of understanding the operation of an automobile can understand the necessary minimum of human body operation to make him an ardent missionary among his fellows. When such a man can understand and reason for himself from the physiological viewpoint he has a deeper concern in the defects of capability, if not in himself, at least in those under his charge.

# Alignment Charts as Management Tools

## Annual Saving of $2000 Brought About in One Case

By F. J. REUTER

*Industrial Engineer*

MENTAL processes, computations and calculations, take time and thus are an operating cost in any manufacturing concern. The rapid development and increased use of mental labor-saving equipment during the past few years is proof that such costs are now undergoing a thorough, critical investigation.

But there are many kinds of calculations which cannot be turned over to an adding or computing machine. On these money is being wasted every day in drawing room and production office through long-hand methods of calculation.

Here and there special slide rules have been made to speed up and lower the cost of such computations. But in many cases the money spent on them has been wasted. Other and better means are available if they will only be utilized. One such, which forms the subject of this short paper is the alignment chart.

**Everyone appreciates the possibilities and advantages of subdividing manual labor and applying labor- and time-saving devices. But the realization is not so widespread that mental labor may likewise be subdivided and devices used to save the effort and time spent in mental work. Mr. Reuter shows how the costs of the infrequent and complicated drawing room and production office calculation may be lowered by use of the alignment chart. He also applies it to analysis and layout purposes.**

The special slide rule has been adopted most extensively by manufacturing concerns especially in connection with computations dealing with operations in cutting metals; while longhand figuring methods are still extensively used in many departments where calculating is important. Both these methods can and should be almost entirely superseded by the use of alignment charts. On these charts figuring, simple as well as complicated, is reduced to the act of reading dimensions. There is not an operation in calculation that alignment charts cannot handle.[1]

To operate a slide rule requires considerable training and mental effort. The graduations are usually only from 1 to 10. This arrangement requires careful attention in handling larger or smaller numbers. The slide rule is not complete in itself for usually one or even several handbooks are necessary to furnish the formulas required for the computation. Again, on a slide rule it is impossible to record the operations performed. Therefore additional paraphernalia, pencil and paper, is required.

The special slide rule is constructed for a single purpose. It has an advantage over the plain rule that the graduations are made to suit the figures to be dealt with, and the operations to be performed are reduced almost to a minimum. But the cost of this kind of tool is so large, and its life so uncertain, that it is a wonder managers have authorized its construction and paid the bill.

To make a slide rule requires: (1) Designing and drafting including laying out the scales; (2) Shop work including the careful fitting of slides and pasting of scales. To use it requires a training period and to acquire dexterity requires considerable experience. This kind of tool, made of wood as it is, after a little time is liable to warp, crack, or break, and the scales are liable to peel off and tear.

In contrast to these limitations an alignment chart can be constructed at a cost varying from one-fiftieth to one-fifth of the cost of a special slide rule made for the same purpose. This cost depends entirely on the refinement required. For example, if the chart is to be used a few times only, pencil lines and the essential graduations are all that are required; if the chart is to be used repeatedly, india ink lines and a sufficient range of graduations on each scale are needed. If several charts are wanted from an original, a tracing and blue prints can be made. To make a chart requires designing and drafting only. This accounts for the low cost compared with the special slide rule's high cost.

Furthermore, an alignment chart, unlike the slide rule, is complete in itself. The figures on the scales are written in decimals, fractions, degrees, large numbers or in any way or in any units that are convenient. The formulas involved are written on the chart together with one or two examples illustrating how to use the chart. These charts last a long time. I have used some for 10 years and they are as good as new now. Yet many pencil lines were drawn across them to record the operations performed. These lines were later erased without injuring the chart. Because the alignment chart is so complete in itself very little

[1] A short but excellent chapter on this subject is found on page 111 of Management's Handbook

training is required to use it. I should say no training, for the requirement is only the reading of the chart.

Alignment charts are not only used for figuring, but also for analyses which are impossible by any other method. It was on one of these charts that I used to analyze the operations performed on brass to produce cartridge shells and on the same chart that the best way of making shells was laid out. In one of many cases, it was shown why a shell was wrongly made and how by minor alterations to the tools several operations could be eliminated. This new layout was approved. The final result was a saving of $2000 per year in producing that piece.

A few years ago a well-known shop management consulting engineer was retained by a large factory where I was employed. There this engineer recommended the construction of special slide rules for various applications. One of them was the calculation of springs. For this work four identical rules were made at a cost of $45 each, or $180 for the lot. They were finally scrapped. It was then that I first saw them and made their acquaintance. Subsequently I called the attention of the responsible executive to an alignment chart found in Halsey's Handbook for Designers. This chart is all that is required for calculating springs; in one, two, three the job is done and is right at that.

After this experience I produced several sets of charts. One of such a set of operating charts is shown in Fig. 1. Charts were made for estimating purposes, time-study calculations, the operations of drawing brass shells and rods, rolling bars and sheets and machine design applications.

All of this development was but a small attempt besides what had been done in this particular field during the Great War at the Creusot Works in France. A shortage of qualified engineers, the great pressure for new designs and the delivery of finished war equipment compelled the chief engineer of the Creusot Works, a former student of Colonel d'Ocague, to use alignment charts in all the departments of the Works where figuring was important. Charts were drawn to convenient dimensions on suitable paper. The result was amazing in the saving of time and money. Jobs which required a unit of time to produce were completed in one-twelfth to one-quarter of that time. With these, without adding one man to the force, the pressure was met.

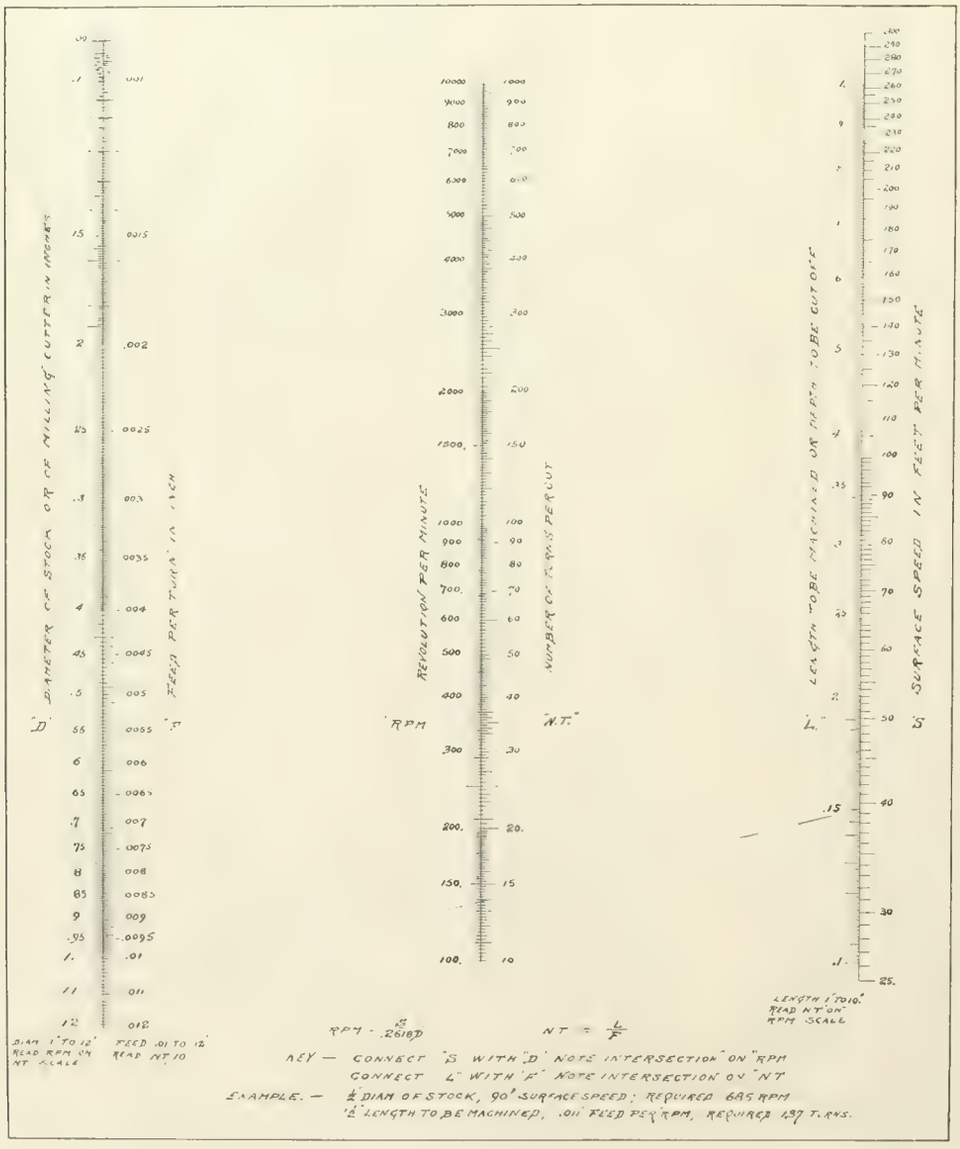
DIAMETER OF STOCK OR CUTTER IN INCHES
FEED PER MINUTE IN INCHES
REVOLUTIONS PER MINUTE
NUMBER OF PASS PER CUT
LENGTH TO BE MACHINED OR PATH TO BE CUT OVER
SURFACE SPEED IN FEET PER MINUTE
"D"
"F"
"RPM"
"N.T."
"L"
"S"
DIAM 1" TO 12" READ RPM ON NT SCALE
FEED .01 TO .12 READ NT 10
LENGTH 1" TO 10" READ NT ON RPM SCALE
RPM = 15 S / .2618 D
NT = L / F
KEY — CONNECT "S" WITH "D" NOTE INTERSECTION ON "RPM"
CONNECT "L" WITH "F" NOTE INTERSECTION ON "NT"
EXAMPLE. — ½ DIAM OF STOCK, 90' SURFACE SPEED; REQUIRED 685 RPM
"L" LENGTH TO BE MACHINED, .011 FEED PER RPM, REQUIRED 137 T. RVS.

FIG. 1 CHART USED TO DETERMINE NUMBER OF REVOLUTIONS PER MINUTE REQUIRED FOR DIAMETER OF STOCK, OR CUTTER

Alignment charts are thus a management tool to save mental labor. Most of the charts which appear from time to time in the technical journals are too small to be anything but models for those who care to redraw them to a suitable scale. Most of my charts are on paper twice letter size, or 11 in. by 17 in. To the best of my recollection the French War Department makes them on sheets approximately 18 in. by 24 in.

The construction of these charts is as much a managerial duty as is the purchase of any time-saving equipment. Individuals are reluctant to spend their spare time drawing charts. Further, it is not convenient for any individual to keep charts around. They should be indexed, classified and readily available to every one on the force.

Simple charts can be made in two or three hours. They will make up for this expenditure many times over during the first month they are in use for calculations, analyses, and layouts.

# Improved Methods Double Production

## Universal Winding Company Increases Output per Employee 100 per cent by Good Management and Wage Incentives

By CHARLES F. O'CONNOR

*Production Manager, Universal Winding Company*

IN 1913 the Universal Winding Company, recognizing that it had a responsibility equal with the workmen in the details of its production work, decided to install scientific management. The new methods were introduced with the assistance of Carl G. Barth. As a result, the management is now held responsible for the securing of the proper material, finding the necessary tool equipment, determining the proper feeds and speeds at which to run machines, determining the best way in which work should be handled, seeing that the material is moved to successive operations and finding out and assigning in each case the next job for each employee to work on.

This proper pre-planning of production removed uncertainty from the workman's task and made possible the establishment of an accurate measure for a day's work. An accurate measurement made possible the developing of deductions from data secured. These deductions, in turn, provided the basis for efficient handling of the business of manufacturing winding machines. In the fourteen years that scientific management has been practiced, the production results have been manifold. The management has been utilizing facilities whose maximum limitations were often thought to have been reached, but which have continued to serve equally well under more efficient methods of handling or manipulation introduced.

The business of the company was established to furnish a machine upon which shoe thread could be wound so as to minimize the loss occasioned through tangles and snarls that occurred in packing and transit. From this predetermined need there arose a multitudinous demand and today machines are in use to wind all kinds of material on and from all kinds of forms. The demand for them is world-wide.

### Problems Introduced by World Market

The world market aspect of the business makes manufacturing a difficult problem, for in forecasting demands there is a correspondingly large circle of influences which have their effects upon forecasts. And while standardization of parts dominant for several types of machine is practiced, there is a steady demand from the field for parts which eliminate standardization as an entity. This condition, in turn, necessitates special handling in manufacture. We shall be concerned more about this later.

Our product is assembled machines, as well as parts for machines already sold but being re-adapted for new purposes, or those needing repair on account of depreciation. Consequently the system of manufacture is one of continuous production of unit parts standard in the various types of machines, as well as those special for particular requirements. Therefore,

*Photographed by Fairchild Aerial Surveys, Inc.*

Fig. 1 Plant of Universal Winding Company, Providence, Rhode Island

our production control is based upon these units.

Before the installation of scientific management, the storeroom was under the control of a foreman who carried the knowledge of the part and its location in his mind. More than that, he knew the special fittings for particular customers. Whenever that foreman was absent the efficiency of the storeroom suffered and the production of the machine assembly department was decreased. Consequently, the storeroom was the first point of attack when scientific management was installed. There has resulted a storage or binning system which provides for predetermined turnovers of stocks so that parts of antiquated design are not accumulated. The material is disbursed in the order of its receipt. This method has resulted in continuous machine production for the unit becoming the control in manufacture. It emphasizes the need for production control over parts as individual units instead of according to machine assembly needs.

Operating under the Taylor plan of scientific management implies that research methods have been adopted in our management. In the case we are considering the final resultant is the unit. Manufacturing units of a like nature brought up the question of procedure for consideration. The machine tools used in manufacture had to be grouped to give maximum efficiency and our study led us to combine like tools together to form departments. Consequently, we have a section known as the lathe department, one as the drill press department in which are grouped all the drills, etc.

We have since learned to limit this arrangement where for particular parts, or group of parts, a saving in manufacturing time and inventory results if the work is carried on as one unit and the machine tools are correspondingly grouped for manufacture. In one bracket job, the former method meant a manufacturing time of 18 weeks. By making an entirely separate job of this part, this time was reduced to 8 weeks in process.

### Market Analysis and Production Determine Inventory

From the sales department information is received which forecasts the demands of the market. With this knowledge of the market and a knowledge of past production performances of the factory an idea is obtained of the average consumption of material and supplies during the immediate future. This estimate furnishes a basis for establishing a control over such material and supplies. If we are able, as we usually are, through an establishment of limits of stock requirements, to eliminate an unnecessary investment in material as well as all unnecessary losses in the factory due to waiting for the ordering and arrival of materials, we are achieving the best results in stores management.

For many months we concentrated on an effort to place our perpetual inventory sheets on machine tabulators for compilation. Our efforts in this direction, however, brought us in touch with a rapid index file which paid for itself in a year's time. This file permits the use of a sheet 11 in. wide by 11¾ in. deep in place of the old sheet which measured 19¼ in. wide by 14 in. deep. The old sheets were cumbersome and lack of space permitted only one person to use a file at a time. We have now ten flat panels on a stand

FIG. 2 PERPETUAL INVENTORY SHEETS AND HOLDERS

which permits the taking out of each panel separately. On each panel are fifty perpetual inventory sheets.

The rapid reference thus possible facilitates the posting of disbursements. More than one person has access to information at the same time. The device is a great saver of both time and floor space. The balance-of-stores or perpetual inventory clerk can post entries without having to go from his desk to the file rack and back again, since the stands allow the files to be placed on a desk. Thus far, we have increased the number of daily individual entries posting per clerk 48 per cent.

A similar posting medium has been adopted for recording the progress of material from department to department. Here again it has given highly satisfactory results, at the same time displacing progress sheets equally as cumbersome as the former inventory sheets.

Both the inventory and progress sheets are serving the purpose of recording individual items which represent parts of winding machines. The inventory sheets record the amount of finished parts on hand. The progress sheets record the steps in the manufacture of processed parts. Together they establish unit control.

To further emphasize this point, consider that in a year's time 25 million parts or units are made and the beginning of their manufacture is the operation

or functioning of the minimum limit that has been established on the perpetual inventory sheet. The diminishing of stock to the minimum point automatically starts the manufacture of another lot of similar parts, all synchronized so that sales quotas are realized, manufacturing facilities are satisfied and financial turnovers made possible.

### Assembly and Shipping Schedules

A customer's order received for a winding machine carries with it the question "When can it be shipped?" Every order received is scheduled to meet the promise date set. Each order is joined to other orders already received so that there is a continuous daily assembling of machines. The limit of the daily assembly is predetermined each quarter and is set for types of machines. Therefore, a machine order received has its particular place set in a particular day with the supposition that its component parts are made. Again unit control!

Movement of material from the finished storeroom to the assembly department is made on standardized trucks and in the order of the assembly. That is to say material moved begins with the legs on which the machine stands and ends with the final screw that finishes the assembly.

When an order for a machine has been received which has a part calling for manufacture of material that is peculiar to a particular machine, that manufacture is not permitted to interfere with regular manufacture. Instead, the parts are machined in a special department which has been created to do such special work. This again emphasizes unit control, for whenever a unit has a special significance it receives special treatment so that it becomes the exceptional item of interest until it has joined the regular items. In this way schedules are not interfered with and the regular flow is maintained.

The average manufacturing time for unit parts is approximately 15 weeks, the average shipping time for completed winding machines is 6 weeks. Consequently, in the constant urge to maintain finished machine shipping schedules, there must be a control which insures satisfaction to the three forces in management—sales, production and finance.

No discussion of management is complete without a reference to production. In this respect, an introduction of the Halsey Premium method at the time of the original management installation in 1913 brought about a production increase in average unit manufacture of 25 per cent. A return to piece rates during the World War period increased production in those same units 40 per cent over the Halsey rates. At the present writing an installation just finished indicates possibilities of a further 15 per cent increase through the medium of a unit system, which includes the indirect worker in the reward attending the increase. Since 1912, therefore, improved methods of management, better facilities and a just sharing of savings with the workers, attended by a growth in business to five times the former volume, with 25 increase in floor space, and 50 per cent increase in number of employees, have increased the output per employee 100 per cent, with no greater exertion of individual human energy than before the more efficient manufacturing and management methods were introduced.

### Many Good Results Are Immeasurable

Like a great many installations of scientific management the results are not all susceptible of a monetary measure. There are tangible results some of which are cited above; there are as many and more intangible ones. All of them can be appreciated only when familiarity with present methods makes one feel the helplessness which would attend the sudden withdrawal of a system built on a careful study of data collected for the sole purpose of determining the best material, the best tool equipment, the proper feeds and speeds to operate tool equipment, the best method to handle and machine the units and the best sequence for manufacture of the units which go to make up Universal Winding machines.

# Computing Relative Speeds of Work to Save Time Study Expense

By ROBERT MAWSON

*Industrial Engineer*

WHEN analyzing machining operations from which time studies are to be compiled it is customary to obtain as one of the primary functions the best speeds at which the various metals may be machined, and along with this the proper feeds. When this data has been obtained it is an easy matter to compute by proportion other time studies for any other sizes of machine parts, made from a similar metal.

Many machine tools are now provided with a speed changing device of an electrical or mechanical nature so that, in combination with the changes of speed provided by gearing in the machine, any desired surface speed may be obtained.

During the compiling of a number of time studies recently for machine work in our plant the procedure was followed of taking one study as the master and from it computing other studies for elements of a similar material and shape. It can readily be seen that this is a great time saver, as it would require a large corps of men and much expense to take individual time studies of all machine parts in a plant

where several thousand varieties are manufactured.

Then again, in our plant many parts of an experimental nature are machined. It would be almost a waste of time to make time studies of such parts and yet it is necessary to produce them as cheaply as possible. This can best be done by putting the jobs on a piece-work or bonus basis.

However, it was found that one machine in the plant, namely, a 42-in. Bullard turret lathe, was not provided with any variable speed device. This machine has table speeds of 3.3, 4.2, 5.2, 7.6, 8.1, 13, 19, 25, 32, 39, and 56 r. p. m. It is kept very busy and most of the parts produced on it are such that they lend themselves very easily to time study, and therefore to a piece-rate system.

Time could not be spared to make studies of all the parts to be machined on this turret lathe. Neither could a fixed speed be maintained for the cutting operations, as this correct speed could not be obtained by the limitations of the machine, as noted.

### Development of Table

To overcome this difficulty Fig. 1 was compiled. The figures were obtained by multiplying the diameter of the work to be machined by 3.1416, then multiplying the result by the r. p. m. of the machine table, and dividing the net result by 12.

For example, taking a diameter of 7 in. and wishing to know the surface speed of the work with the machine traveling at 10 r. p. m., we have

$$\frac{7 \times 3.1416 \times 10}{12} = 18.32 \text{ ft. per min.}$$

Looking in the table for 10 r. p. m. at the head of one of the vertical columns, and reading across from the 7 in. diameter in the vertical column at the left, it will be seen that 18.32 is given as the surface speed, which is the same as obtained from the above example.

To use the table, when the correct speed has been obtained from a time study and another study is to be computed, read the diameter to be machined across until the nearest proper cutting speed is found, and vertically up from this to the column head, and the latter figure will be the correct r. p. m.

Let us take an example. When timing a gear it is found that 70.7 ft. per min. is the best cutting speed. This gear is 27 in. in diameter, has a 4 in. face and requires 50.61 min, to turn up at a certain feed. What speed should the machine be run to cut a gear of 32 in. diameter, and if the gear has a 6 in. face what time must be allowed for the operation if the feed is the same as for the previous gear?

We will assume that the speed of 70.7 ft. per min. is as fast as the tool will stand without being destroyed and therefore it must not be increased. Reading across the horizontal line for a diameter of 32 in. and vertically down from 10 r. p. m., which is the speed of the table for 70.7 ft. per min. and a diameter of 27 in., it will be seen that the new speed is 83.8 ft. per min. As this is above the limit of 70.7 we cannot run the table at this speed.

| Diameter in Inches | R. P. M. 5.2 | 7.6 | 8 | 10 | 13 | 19 | 25 | 32 | 39 | 56 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | 16.78 | 20.43 | 29.35 |
| 3 | | | | | | | 19.66 | 25.15 | 30.65 | 44.0 |
| 4 | | | | | | 19.9 | 26.2 | 33.55 | 40.8 | 58.7 |
| 5 | | | | | | 24.9 | 32.8 | 41.9 | 51.1 | 73.4 |
| 6 | | | | | 20.45 | 29.8 | 39.3 | 50.3 | 61.3 | 88.0 |
| 7 | | | | 18.32 | 23.8 | 34.8 | 45.9 | 58.6 | 71.5 | 102.8 |
| 8 | | | | 20.95 | 27.2 | 39.8 | 52.4 | 67.0 | 81.7 | 117.4 |
| 9 | | | 18.88 | 23.6 | 30.65 | 44.8 | 59.0 | 75.4 | 91.9 | |
| 10 | | 19.9 | 20.95 | 26.2 | 34.05 | 49.8 | 65.5 | 83.8 | 102.1 | |
| 11 | | 21.9 | 23.05 | 28.8 | 37.45 | 54.8 | 72.05 | 92.2 | 112.3 | |
| 12 | | 23.9 | 25.15 | 31.42 | 40.85 | 59.7 | 78.6 | 100.7 | 122.6 | |
| 13 | | 25.85 | 27.2 | 34.05 | 44.25 | 64.7 | 85.1 | 109.0 | | |
| 14 | | 27.85 | 29.35 | 36.65 | 47.6 | 69.6 | 91.7 | 117.3 | | |
| 15 | | 29.85 | 31.42 | 39.3 | 51.1 | 74.6 | 98.25 | | | |
| 16 | | 31.85 | 33.55 | 41.9 | 54.5 | 79.5 | 104.9 | | | |
| 17 | | 33.82 | 35.6 | 44.5 | 57.9 | 84.5 | 111.2 | | | |
| 18 | | 35.8 | 37.75 | 47.2 | 61.3 | 89.5 | 118.0 | | | |
| 19 | | 37.8 | 39.8 | 49.75 | 64.6 | 94.5 | 124.5 | | | |
| 20 | | 39.8 | 41.85 | 52.4 | 68.1 | 99.5 | | | | |
| 21 | | 41.8 | 44.0 | 55.0 | 71.5 | 104.5 | | | | |
| 22 | | 43.8 | 46.1 | 57.6 | 74.9 | 109.4 | | | | |
| 23 | | 45.8 | 48.2 | 60.2 | 78.4 | 114.3 | | | | |
| 24 | | 47.8 | 50.3 | 62.8 | 81.6 | 119.2 | | | | |
| 25 | | 49.8 | 52.4 | 65.5 | 85.1 | 124.2 | | | | |
| 26 | | 51.8 | 54.5 | 68.1 | 88.5 | | | | | |
| 27 | | 53.75 | 56.6 | 70.7 | 91.9 | | | | | |
| 28 | | 55.75 | 58.7 | 73.3 | 95.3 | | SPEED IN | | | |
| 29 | | 57.75 | 60.8 | 76.0 | 98.7 | | FEET | | | |
| 30 | 40.8 | 59.75 | 62.9 | 78.5 | 102.2 | | PER MINUTE | | | |
| 31 | 42.2 | 61.7 | 65.0 | 81.2 | 105.5 | | | | | |
| 32 | 43.6 | 63.7 | 67.1 | 83.8 | 109.0 | | | | | |
| 33 | 44.9 | 65.7 | 69.2 | 86.4 | 112.3 | | | | | |
| 34 | 46.3 | 67.7 | 71.2 | 89.0 | 115.9 | | | | | |
| 35 | 47.7 | 69.7 | 73.3 | 91.7 | 119.2 | | | | | |
| 36 | 49.0 | 71.65 | 75.4 | 94.3 | | | | | | |
| 37 | 50.4 | 73.65 | 77.5 | 96.9 | | | | | | |
| 38 | 51.75 | 75.6 | 79.6 | 99.5 | | | | | | |
| 39 | 53.2 | 77.6 | 81.7 | 102.2 | | | | | | |
| 40 | 54.5 | 79.6 | 83.8 | 104.8 | | | | | | |

FIG. 1 DATA FOR DETERMINING BULLARD LATHE SPEED

We therefore drop down the table speed to the next lower, which is 8 r. p. m., and equals a cutting speed of 67.1 ft. per min. The time to be allowed is:

$$\frac{32 \times 6 \times 50.61 \times 10}{27 \times 4 \times 8} = 112.46 \text{ min.}$$

The computation is one of simple multiplication and division. The only element to be careful about is to notice that the ratio of table speed is inverted, as by operating slower longer time is required for the machining of the gear.

Similar tables can easily be compiled for any machine tool by obtaining the speeds in r. p. m. of the machine. They facilitate time study computations to a remarkable degree.

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## Editorial Correction in Buick Article

On page 88 of the February issue, in the article "Buick Saves $3,500,000 in Nine Months," the words "expense of materials" in the last paragraph should read "expense materials." The Buick Company has not in any way reduced the quality of materials going into its automobiles.

# The Barth Standard Wage Scale

## Discussion and Reply

BY CHARLES D. DEMOND
*Mechanical Engineer*

THE editorial introduction to The Barth Standard Wage Scale, on page 357 of your December 1925 issue, refers to the psychology of the problem. This discussion may be helpful from another mental angle, in that it bridges the gap between the arithmetical and the geometrical points of view.

To warrant the suggested scale we observe how little variation occurs between the amounts finally assigned and the exact calculations. The latter are as follows, the factor being 1.1487:

| | |
|---|---|
| 10.0 | 69.6 |
| 11.5 | 80.0 |
| 13.2 | 91.9 |
| 15.2 | 105.6 |
| 17.4 | 121.3 |
| 20.0 | 139.3 |
| 23.0 | 160.0 |
| 26.4 | 183.8 |
| 30.3 | 211.1 |
| 34.8 | 242.5 |
| 40.0 | 278.6 |
| 46.0 | 320.0 |
| 52.8 | 367.6 |
| 60.6 | 422.2 |

The adjustments in the proposed series are made primarily to bring the rates to even tens or fives. In general the adjustment is to the nearest 10 (or five or two); but a strict following of this rule would bring 110 where 100 is adopted, and 210 where 200 is taken; but the rates chosen at these two points make the series more systematic.

The scale submitted maintains the sound logic and fairness of the Barth plan; and the fact that it incidentally makes a moderate concession to the arithmetical method should serve as a means to adoption of the better way.

In Mr. Barth's standard wage scale any rate is approximately twice as much as the fifth preceding amount. By figuring an exact ratio of two to one between such rates, and making moderate adjustments from the exact calculations (as Mr. Barth did), it is seen that several things can be accomplished. We note that in the Barth series there are four two-cent intervals at the beginning. In the series shown below there are two-cent intervals up to 22 cents; from 25 to 50 each interval is five cents; ten cents from there to one dollar; 20 cents from one to two dollars, etc. The elimination of a number of such final digits as 2, 7 and 9 in the medium and higher rates is an application, or rather an extension, of the idea that "all rates should be in even cents."

At all points the sound logic of the geometrical progression is reasonably well maintained; but enough of the idea of arithmetical progression occurs in the group of 10-cent intervals, and in other groups, to make the plan acceptable where it would not otherwise be adopted. There are many who find much convenience and satisfaction by carrying their financial thinking in terms of tens. Moreover, there are advantages in the decimal intervals from the clerical point of view. It will noticeably lessen the work and save expense in making up the pay roll, because competent clerks can make most of the extensions instantly, without consuming time on rate tables or calculating machines.

| *Hourly rate in cents* | *Approximate monthly pay* | *Hourly rate in cents* | *Approximate monthly pay* |
|---|---|---|---|
| 10 | $ 20 | 60 | |
| 12 | | 70 | |
| 14 | | 80 | |
| 16 | | 90 | |
| 18 | | 100 | $200 |
| 20 | $ 40 | | |
| | | 120 | |
| 22 | | 140 | |
| 25 | $ 50 | 160 | |
| | | 180 | |
| 30 | | 200 | $400 |
| 35 | | | |
| 40 | | 240 | |
| 45 | | 280 | |
| 50 | $100 | 320 | |

BY CARL G. BARTH
*Consulting Engineer*

I have read with interest Mr. Demond's letter proposing an alternative to the standard wage scale submitted by me in the December issue of this journal, and I am gratified that somebody has evinced the interest to give the matter some serious consideration.

The recurring factor 2 in Mr. Demond's scale impresses me most favorably, and I am pleased that he recognized what I failed to do, that my basic ratio 1.15 (15% increase) is so close to 1.1487 or $\sqrt[6]{2}$. Also, the indisputable computing value of the decimal differences of his final adjusted scale cannot fail to have a strong appeal.

But still I am unable to give my unqualified approval

of the great deviation from my original attempt at a scale whose terms of whole numbers should as far as possible bear the same ratio to each other, which this intentional mixture of arithmetical and geometrical progressions produces in Mr. Demond's suggested scale, in which the final ratios vary from a minimum of 1.1 (10% increase) to a maximum of 1.2 (20% increase).

Taking, therefore, the basic ratio $\sqrt[8]{2} = 1.1487$ and using it as I originally did the ratio 1.15, and letting down a trifle on the condition that the ratios should be the closest possible to the basic one, and further letting down, on rates below 20 cents, on the requirement that the terms must all be whole numbers, I herewith modify my scale to

| | |
|---|---|
| 10 | 60 |
| 11.5 | 70 |
| 13 | 80 |
| 15 | 92 |
| 17.5 | 104 |
| 20 | 120 |
| 23 | 140 |
| 26 | 160 |
| 30 | 184 |
| 35 | 208 |
| 40 | 240 |
| 46 | 280 |
| 52 | 320 |

The minimum ratio of this scale is 1.13; the maximum is 1.1667.

It will be seen that several of the terms in this scale are identical with those of Mr. Demond's, so that part of the computing advantages of his scale also belongs to this scale. This may be further increased by making a slight break in the scale by substituting 90 for 92 and then follow with terms that are 10 times the first terms, etc., in the scale, thus:

| | |
|---|---|
| 10 | 60 |
| 11.5 | 70 |
| 13 | 80 |
| 15 | 90 |
| 17.5 | 100 |
| 20 | 115 |
| 23 | 130 |
| 26 | 150 |
| 30 | 175 |
| 35 | 200 |
| 40 | 230 |
| 46 | 260 |
| 52 | 300 |

This unfortunately lowers the minimum ratio to 1.111 (100 ÷ 90), but even so the extremes are decidedly closer together than those in Mr. Demond's scale; and on the whole I think it is a decided improvement on my original scale, and a fair example of the value of co-operative efforts, even at a distance.

The rather puzzling fact that I overlooked that the number 1.15 is so close to $\sqrt[8]{2}$, is no doubt due to the circumstance that my original article was prepared, at the request of a friend, principally in the spirit of a reminiscence, and not in the spirit of seriously advocating a standard wage scale to be generally adopted. For as is well known, I am a strong advocate of roots of the simple number 2, as against roots of the more complex number 10, as brought out in my discussion of the paper on Preferred Numbers read before the American Society of Mechanical Engineers.[1]

Years before we ever heard of the term preferred numbers I established and advocated the ratio $\sqrt[4]{2}$ for an ideal speeds and feeds series for machine tools (tool machines), though this was later than my first conception of a standard wage scale. However, I believe there are many cases in which it would be more in order to arrive at a series of preferred numbers in the manner in which I established my original wage scale; namely, not by adjusting the terms of an established perfect geometrical progression, but by arriving at each final number in succession, by multiplying its preceding and previously adjusted number by the ratio adopted, whether this be a root of 2 or 10, or anything else. It seems to me that in many cases the paramount consideration should be the closest uniformity of the several resulting ratios that is obtainable under such limitations as that the numbers must be whole numbers or limited fractions, or anything else.

[Mr. Barth recognized the value of applying a law to wage scales and feeds and speeds of machine tools many years ago, as he says, "years before we ever heard of the term preferred numbers . . ." However, preferred numbers are but a series of values developed according to a mathematical law. They are largely used in France and Germany to determine proportions, sizes, dimensions and ratings of industrial equipment. The more the possibility is recognized of formulating laws in developing management methods, the greater will be our progress.

Preferred numbers:

1. Establish a minimum of standard sizes and ratings.
2. Eliminate odd and special sizes and ratings.
3. Simplify and cheapen production.
4. Simplify calculations.
5. Provide easy methods to halve or double sizes or ratings in a preferred series.
6. Provide easy method to reconcile and determine conflicts in practice because of adoption of a law.
7. Produce products so designed that even if made in different industries they will fit together when assembled.

—The Editors.]

[1] December, 1922 meeting.

# The Guide to Latest Information

## One Hundred Best Selections for May*

By THE EDITORS

THIS month's extensive critical review of the latest available magazines and recent books show that an increasing number of American factories are energetically attacking difficult management problems and working out successful solutions. Improved production methods have brought about big savings, many noted below. Economies of power generation and transmission within the plant and the cost-saving phases of material handling are increasingly prominent. Well-equipped buildings and sound understanding of labor relations, as management's contribution, are developing capable and contented working forces. Much new useful and cost-reducing industrial equipment has been put on the market.

Altogether, sound, steady progress toward better methods of administering the activities and directing the operations of manufacturing plants is strikingly evident.

## Industrial Buildings and Plant Maintenance

### Buildings and Equipment

**Intelligent Planning of Plant Additions**

Norman L. Samans. Factors to analyze in advance of actual construction. *Industrial Management*, Mar. 1926, pp. 161-3. Index no. 658.23.

**Labor-Saving Equipment Features New Westinghouse Air Brake Plant**

G. W. Wilder, general manager, describes the construction, layout and equipment of a new building 920 ft. long and 3 stories high for foundry and machine shop work. The foundry contains the very latest and best installation of mechanical equipment ever provided for the economical production of castings. MANUFACTURING INDUSTRIES, May 1926, pp. 337-42. Illus. Index no. 658.2.

**New Methods in an Old Industry**

C. M. Faunce. Description of the million-dollar plant of the California Baking Co. *Industrial Gas*, March 1926, pp. 7-8, 24, 26. Illus. Index no. 658.2.

**Planning Lighting System for a Tire Factory**

Philip C. Jones. Method of determining size and the number of lamps necessary for the illumination required and factors that influence layout of distribution system in the Goodyear Tire and Rubber Co. plant at Akron. *Industrial Engineer*, Apr. 1926, pp. 160-164. Illus. Index no. 658.242.

**The Strategic Value of Locating Near the Sea**

John A. Piquet. Great opportunities for low-cost production and world markets lie in our coming port cities. *Industrial Management*, Mar. 1926, pp. 184-7. Illus. Index no. 658.21.

### Maintenance and Repair

**Your Factory's Dust Problem and How to Meet It**

K. D. Hendrickson. I. How to control dust in manufacturing plants, with illustrations and descriptions of equipment. *Factory*, Mar. 1926, pp. 446-9, 504, 570, 572, 574, 576, 578. Illus. II. Practice of the George J. Keath Company in controlling and removing dust. *Factory*, Apr. 1926, pp. 650-4, 748, 750, 752, 754, 756, 758, 760. Illus. Index no. 658.239.

## Organization, Management and Administration

**Alignment Charts as Management Tools**

F. J. Reuter. Costs of infrequent and complicated drawing room and office calculations may often be lowered by the use of alignment charts. The author gives examples. MANUFACTURING INDUSTRIES, May 1926, pp. 367-8. Illus. Index no. 658.53.

**Bonus System Pays in Hoosier Plant**

F. G. Metzman, general manager, shows that although equipped and operated according to the most-up-to-date manufacturing developments, the Hoosier Manufacturing Co., makers of kitchen cabinets, bring about substantial production increases and wage re-

*The contents of this section are compiled from the Periodical Publications Department of the Library of Congress, Washington, D. C., and the Business Branch of the New York Public Library, New York City. Readers who desire to consult any of the publications mentioned should apply to the Business Branch of the New York Public Library, which has the most complete collection of business periodicals in the world. Over 25 cents per copy for photographic charges.

Periodicals indexed currently are listed alphabetically at the beginning of each group. Books are listed at the end of each group. Each item is followed by a reference to the Index No. of the Library of Congress, by which the item appears.

**Getting the Most Out of Your Machine Tool Dollar**

Jerome R. George. Methods used to select and buy equipment adopted by the Morgan Construction Co. *American Machinist*, Mar. 11, 1926, pp. 381-3. Index no. 658.27.

**Improved Methods Double Output**

Charles F. O'Connor. In 1913 the Universal Winding Co. installed the Taylor System of Scientific Management which has operated successfully for the past 14 years. The new methods as gradually improved upon, have doubled the production per employee, with an increase of only 25 per cent in floor space, and 150 per cent in number of workers. MANUFACTURING INDUSTRIES, May 1926, pp. 369-71. Illus. Index no. 658.5.

**Investigation of Business Problems**

J. Engelbertner. A. W. Shaw Co., Chicago. 335 pp. $5. This book has its origin in a group of instructions developed to assist new men to enter the author's department. In its present form there have been two distinct purposes behind its arrangement: First, to present a thorough analysis of technique and procedure of investigating business problems; and second, providing practical training for the research worker. The nature of the information presented is indicated by the chapter headings: Field of Investigation; Investigational Procedure; Qualifications of the Investigator; Preliminary Analysis; Proper Mental Attitude; Methods of Collecting the Facts; Personal Observation and Experiment; Bibliographical Research; Interviews; Questionnaires; Nature of Thinking; Definition and Classification; Testing and Interpretation; Induction and Prediction; Suggestion and Inference; Developing the Conclusion; Establishing the Conclusion; Preparing the Report. Index no. 658.

**Keeping Research on a Business Basis**

George J. Hagenbuch. Organization and operating methods of the General Motors Corporation Research Laboratories at Detroit, one of the most progressive, capable and completely equipped departments of its kind in the world. MANUFACTURING INDUSTRIES, May 1926, pp. 359-62. Illus. Index no. 658.57.

**One-Day Production**

Edward Carlson. The Kardex-Rand Co. is using today half as many men for and of

product as were required two years ago. This striking reduction has been brought about by organizing machines and groups, simplified layout, and arranging for straight-line production. *Factory,* Mar. 1926, pp. 433-5, 464, 466, 538, 540, 542. Illus. Index no. 658.5.

**Short Cuts to Accurate Order Filling**

John G. Aldrich. Methods by which the New England Butt Co. is enabled to fill orders for machines and repair parts promptly and accurately. Extensive engineering department records and a convenient means of filing orders after filling provide complete data for reference when new orders are received. MANUFACTURING INDUSTRIES, May 1926, pp. 335-6. Illus. Index no. 658.81.

**Technique of Executive Control in Shop Management**

Wallace Clark. *Society of Industrial Engineers Bulletin,* Mar. 1926, pp. 11-17. Index no. 658.5.

**Value of Research Work to the Industry**

J. T. Howington. Value of research work to the clay products manufacturer, with particular stress on improvement of product and scientific attack on merchandising. *Brick and Clay Record,* Mar. 30, 1926, pp. 548-9. Index no. 658.57.

**Warring Against the Idle Dollar**

E. M. Herr. How stabilization, simplification, standardization, and employee co-operation can hold down your investment in stock. Experience of the Westinghouse Electric & Manufacturing Co. *Factory,* Mar. 1926, pp. 427-30, 502. Illus. Index no. 658.5.

# Power Generation and Transmission

## Power Generation

**Economy Due to Power Factor Correction**

E. N. Dittenhofer. In the plant of the Gotham Silk Hosiery Co. overall power factor was increased from 49.9 to 91.4 per cent. This article describes methods adopted to bring this improvement. *Power Plant Engineering,* Apr. 1, 1926, pp. 425-6. Index no. 658.26.

**Extracted Steam Solves Power Problems**

Descriptions of equipment, methods of operation of the power plant of the Proximity Manufacturing Co., a textile plant which operates 1600 looms and 55,000 spindles. Boilers operate at 200 lb. pressure, with 100 deg. superheat, and steam at 15 lb. pressure is bled from the turbine for the dye house supply. During the first month of operation of the new equipment 104 tons less coal were used than during the corresponding month of the previous year. *Power,* Mar. 30, 1926, pp. 474-7. Illus. Index no. 658.26.

**How to Decrease Boiler Plant Costs**

Russell B. Williams. Simple, inexpensive system of recording result of boiler plant operation and to point out possibilities of saving. *Steam Coal Buyer,* Mar. 1926, pp. 31-3. Illus. Index no. 658.261.

**Keeping Cost in a Small Power Plant**

Specimen instrument charts, report sheets and log of daily operating costs. *Power,* Mar. 30, 1926, pp. 489-91. Illus. Index no. 658.261.

**New National Biscuit Company Plant at Philadelphia**

New power plant of 684 boiler horsepower capacity serves new eight-story bakery in Philadelphia with electricity, steam and refrigeration for all purposes. *Power Plant Engineering,* Apr. 1, 1926, pp. 406-10. Illus. Index no. 658.26.

**Oil Engines Drive Georgia Brick Plant**

Description of the new plant, equipped with three Fairbanks-Morse and Co. oil engines. Total rated capacity 500 hp. Exhaust heat is used in the brick drier. *Power,* Mar. 30, 1926, pp. 481-2. Illus. Index no. 658.26.

**Plant Addition Results in Large Savings**

W. R. Hoback. Methods which brought about a saving of 50 per cent in fuel consumption in the power plant of the Gager Lime and Manufacturing Co. *Power Plant Engineering,* Mar. 15, 1926, pp. 367-9. Illus. Index no. 658.26.

**Power Factor and Means for Its Improvement**

General Electric Co. Bulletin GEA-232. 33 pp. Methods of power factor improvement in industrial plants, equipment for the purpose, tables of data. Index no. 658.26.

**Shop Power Plant Shows Economical Operation**

Layout and equipment of the power plant of the Sullivan Machinery Co. The prime movers are uniflow engines. *Power Plant Engineering,* Mar. 15, 1926, pp. 377-9. Illus. Index no. 658.261.

**Stoker-Fired Boiler Unit Develops High Efficiency**

Description of the new boiler unit of the Brown and Sharpe Manufacturing Co. with results of 24-hour test indicating the efficiency of boiler, furnace and grate to be 83.17 per cent. *Power,* Mar. 17, 1926, pp. 398-9. Illus. Index no. 658.261.

## Power Transmission

**Capacity of Belts Under Operating Conditions**

R. F. Jones. Data on relative power transmitting capacity of leather belts on vertical and angular drives as determined under a series of service condition tests carried on at Cornell University by the Leather Belting Exchange Foundation. *Industrial Engineer,* Apr. 1926, pp. 165-70. Illus. Index no. 658.262.

# Marketing and Distribution

## Advertising

**Principles of Publicity**

Glenn C. Quiett and Ralph D. Casey. D. Appleton and Co., New York. 420 pp. $3. Written to define publicity in its modern setting and to give an extended and practical exposition of its methods. Distinguishes between responsible and unreliable information, commonly called propaganda, and between the functions of publicity and advertising. Based upon experiences in newspaper and magazine work and in the special field of publicity. Topics cover: Practice of publicity; dealing with the news executives; news and feature stories; writing pamphlets; printing; the trade press; house organs; motion pictures; news pictures; exhibits; business publicity; publicity for public schools, universities and colleges, institutions, churches, civic associations; conducting of publicity campaigns. Index no. 659.1.

**Rating System for Words in Advertising Copy**

Richard Surrey. *Printers' Ink,* Mar. 11, 1926. pp. 105-10. Index no. 659.1.

## Selling

**First Step in a Market Survey**

H. L. Keely. The author presents the four major questions which must be answered in making a market survey, and presents a chart bringing together all of the accompanying factors in their proper sequence and arrangement. MANUFACTURING INDUSTRIES, May. 1926, pp. 355-8. Illus. Index no. 658.82.

**Planning Work of the Sales Promotion Department**

R. R. Harris. Ten important activities as included in the program of the Standard Conveyor Co. *Class,* Apr. 1926, pp. 50, 52. Index no. 658.82.

**Selling Cost 14 Per Cent in the Industrial Field**

Engineering Advertisers' Association questionnaire shows average advertising expenditure of 2.68 per cent of sales volume. *Class,* Apr. 1926, pp. 24, 26. Index no. 658.8.

**What Expenses Should Be Charged to the Sales Account?**

John Allen Murphy. How to determine whether an expenditure belongs to production or selling. *Printers' Ink,* Mar. 25, 1926, pp. 17-20. Index no. 658.8.

## Packing, Shipping, Transportation

**Box Board Thicknesses**

Simplified Practice Recommendation No. 44. U. S. Dept. of Commerce. Pamphlet. 11 pp. Recommended simplified thicknesses for box board, adopted April 29, 1925. Index no. 658.78841.

**Car Inspector and Freight Claim Prevention**

W. R. Rogers. Proper investigation by qualified employees would aid in fixing responsibility for damage. *Railway Mechanical Engineer,* Apr. 1926, pp. 229-30. Index no. 658.788.

**Paper Grocers' Bags**

Simplified Practice Recommendation No. 42. U. S. Dept. of Commerce. Pamphlet, 13 pp. Recommended standards for capacities, colors, qualities and strength of paper of grocers' bags, adopted on May 26, 1925. Index no. 658.78841.

**Will Use Wooden Barrels for Rosin and Turpentine**

A. C. Hughes. The Naval Stores Package Committee at a convention in New Orleans, Mar. 1, 2, and 3, 1926, declared that the metal package for shipping and handling rosin was not practical and the present wooden package was satisfactory. *Barrel and Box,* Mar. 1926, pp. 9-10. Illus. Index no. 658.78844.

# Production Control and Material Handling

## Production Control

### Computing Relative Speeds of Work to Save Time Study Expense

Robert Mawson. Method of developing tables of machine speeds for different kinds of work from time study and other data previously collected on related jobs. MANUFACTURING INDUSTRIES, May 1926, pp. 371-2. Illus. Index no. 658.542

### Control of Inventory Through the Scientific Determination of Lot Sizes—VI

H. S. Owen. The Process Routing of Piece parts. *Industrial Management*, Mar. 1926, pp. 164-6. Illus. Index no. 658.512

### Reducing Costs 22 Per Cent by Motion Study

Jos. A. Piacitelli. Conclusion of the article by the same title which appeared in the April issue of MANUFACTURING INDUSTRIES. As a further instance in reducing costs a case is presented where 35 per cent reduction was made in the expense of shipping product. MANUFACTURING INDUSTRIES, May 1926, pp. 347-50. Illus. Index no. 658.542.

### Repairing Locomotives at Pennsylvania Railroad at Juniata Shop—I

Scheduling system, material delivery, inspection methods, and standardized repair parts are outstanding features. *Railway Mechanical Engineer*, Apr. 1926, pp. 237-44. Illus. Index no. 658.5.

### Systematize Cleaning Operations

J. D. Towne. Management study of equipment, layout, working force, and methods of performing different operations, resulted in reducing the number of employees 37½ per cent. *Foundry*, Apr. 1, 1926, pp. 280-2. Index no. 658.5.

## Production Processes

### Applying Electric Heat in Industrial Plants

N. R. Stansel. Discussion of the application of bulk heating, localized heating, and heat treatment process, including worked out examples to aid in solving industrial heating problems. *Industrial Engineer*, Apr. 1926, pp. 154-9, 176. Illus. Index no. 658.27:669.8.

## Material Handling

### Analysis of Operating Costs of Automotive Equipment

Joseph Scott. Operating costs; determination of economic life of equipment; cost of obsolescence and repairs; chassis repair costs, etc., as determined through a study made by the Bureau of Power and Light, City of Los Angeles, Cal. *Society of Automotive Engineers Journal*, Apr. 1926, pp. 367-70. Illus. Index no. 658.281.

### Conveyors Nearly Triple Output

F. L. Prentiss. Description of the power-driven conveying systems used in the foundry of the Saginaw Products Co., a division of General Motors Corp. One molding unit produces 2000 Chevrolet cylinder blocks in a 9-hr. day. *Iron Age*, Apr. 8, 1926, pp. 977-82. Illus. Index no. 658.2812.

### Lower Handling Costs of Foundry Materials

Harold J. Payne. Use of electric industrial trucks for coal and castings, and lift type trucks with platforms for other materials. *Foundry*, Apr. 1, 1926, pp. 262-7. Illus. Index no. 658.281.

### Selecting Storage Battery Charging Equipment

John H. Hertner. Discussion of the charging requirment of lead and alkaline batteries and characteristics of equipment best suited to industrial trucks. *Industrial Engineer*, Apr. 1926, pp. 171-6. Illus. Index no. 658.281.

### What Executives Can Learn from the Automotive Industry—II

Jervis B. Webb. The overhead conveying system, as applied to progressive manufacture. Illustrated description of overhead conveyors. *Industrial Management*, Mar. 1926, pp. 151-6. Illus. Index no. 658.281.

# Employment and Personnel Management

## Personnel Management

### Building Worker-Management Relations on Full Sharing of Facts

Carl F. Deitz. Methods of the Bridgeport Brass Co. in keeping employees informed as to progress and condition of business. *Factory*, Apr. 1926, pp. 627-30. Illus. Index no. 658.315.

### Experience with Group Insurance

National Metal Trades Association, Chicago. Pamphlet, 26 pp. Report of the Committee on Industrial Relations of the National Metal Trades Association based on a questionnaire to the members of that organization. The principal conclusion is: Group life insurance is undoubtedly one form of co-operative effort whereby the employer may be of real benefit to the employee and his family. Index no. 658.3253.

### Promoting Employee Teamwork and Welfare Without Paternalism

C. A. Lippincott. How the Studebaker Corporation handles the problem of industrial relations. *Industrial Management*, Mar. 1926, pp. 146-50. Illus. Index no. 658.315.

## Remuneration

### Barth Standard Wage Scale

Charles D. Demond and Carl G. Barth. MANUFACTURING INDUSTRIES, May 1926, pp. 373-4. Index no. 658.322.

### Finding the Worth of a Man's Work

J. Osborne Hopwood. Relative values of the different kinds of work in an organization. *Industrial Management*, Mar. 1926, pp. 176-83. Illus. Index no. 658.3215.

### Group System of Wage Payment—II

Harold B. Maynard and G. J. Stegemerten. Second article dealing with details of operation of a group system for paying wages in use at the East Pittsburgh plant of the Westinghouse Electric and Manufacturing Co. *Industrial Management*, Mar. 1926, pp. 167-72. Illus. Index no. 658.32.

## Health and Safety

### Fatigue From a New Point of View

Howard W. Haggard. The author shows how the capability for doing work of an individual is affected by the condition of the body. This means, he declares, that physiology provides information of the greatest value to industrial managers in carrying on work in manufacturing. MANUFACTURING INDUSTRIES, May, 1926, pp. 363-6. Index no. 658.544.

### First Aid Rooms in Small Plants

Number One of Industrial Health Series prepared by Policyholders' Service Bureau, Metropolitan Life Insurance Company. 12 pp. Organization; personnel; first aid room and equipment; records. Index no. 658.382271.

### First Principles of Industrial Posture and Seating

Special Bulletin no. 141, State of N. Y. Department of Labor. Jan. 1926. 12 pp. Illus. Illustrates correct and incorrect chairs and stools, and gives hints in regard to proper posture, both standing and sitting. Index no. 658.3822

# Financial Control and Accounting

## Financial Control

### Operating and Balance Sheet Ratios

Arthur Anderson. MANUFACTURING INDUSTRIES, May 1926, pp. 451-4. Index no. 658.14.

## Accounting and Cost Finding

### Accounting Systems

George E. Bennett. A. W. Shaw Co. Chicago. 554 pp. Flexible binding $7.50. Written for business men and students of accounting. Principles and problems of installation are discussed from the standpoint of the average trading, service, and manufacturing concern of small and moderate size. The text shows how things actually are done, rather than laying down theories as to how they should be done. Explains the theory of record expansion; stores and purchasing; sales; cash; cost accounts in manufacturing; internal check factors; installation preliminaries; charts and plans of layout and organization; charts of accounts; commission selling; accounting in foundries, machine shops, knit goods factories, and trading and merchandizing organizations. Ninety-seven useful forms are included. Index no. 657.4.

### Cost Estimates for Operating Engineers

James E. Foster. Common-sense article showing how to analyze fixed charges and operating costs of an industrial power plant. *National Engineer*, Apr. 1926, pp. 161-2. Index no. 657.452.

### Cost Summaries and Procedures in Ice Cream and Candy Manufacture

E. J. Atkins. Outline of the items of manufacturing cost, selling and advertising expense, branch plant expense and the cost of operating the delivery department. *National Association of Cost Accountants Bulletin*, Apr. 1, 1926, pp. 557-62. Index no. 657.452.

### Engineering Costing and Works Accountancy—Its Objects and Necessity

Roland Dunkerly. *National Association of Cost Accountants Bulletin*, March 15, 1926, pp. 513-21. Index no. 657.452.

### Predetermined Costs as Applied to Paper Mills

C. R. Stevenson. *Paper Trade Journal*, Mar. 18, 1926, pp. 61-6. Index no. 657.452.

### System of Paper Mill Cost Accounting

C. W. Halligan. *Paper Trade Journal*, Mar. 11, 1926, pp. 34, 36, 38. Illus. Index no. 657.452.

# Miscellaneous

## Economics

### Five Years of American Workers' Education

Spencer Miller, Jr. Outline of the work done by the Workers Education Bureau, the national clearing house of information and guidance for the education of American workers. *American Federationist*, Mar. 1926, pp. 336-9. Index no. 331.85.

### Hides and Skins

John R. Arnold. A. W. Shaw Co., Chicago. 606 pp. Flexible binding. $6. First of a series of books, edited by J. Anton de Haas, and dealing with the raw markets of the world. Gives detailed information concerning the economic, commercial and financial aspects of the widely scattered sources of leather supply. Peculiar market center usages, conditions under which the product is produced, price determinations, social factors and governmental regulations at the source of supply, and international commercial policies in relation to raw materials, are all covered. Important topics discussed are: Nature and economic relations of hides and skins; basic physical qualities; take-off methods; curing; defects; methods and standards of grading; trade organizations and contracts; restrictions and other factors in international trade; prices; hide production; detailed information on many kinds of skins. Index no. 675:380.012.

### Manufacturers of the State of Washington

The Manufacturers' Association of Washington, Seattle, Washington, 346 pp. $10, including monthly service advising of changes, etc. This is the eighth edition of the Directory of the Manufacturers Association of the State of Washington. The first 173 pages are devoted to an alphabetical list of the manufacturing firms and addresses, telephone numbers, names of executives, number of employees and the products made. Then follow four pages of brands and trade marks, and 140 pages of a commodity index. Twenty-three pages give geographical grouping of the manufacturers. Publications of this kind are of very great value, and in expressing appreciation of the one under review, it is not out of order to wish that a similar volume might be printed annually by the Manufacturers' Association of each of the great industrial states. Index no. 31:67.

### Newer Methods in the Stabilization of Employment

Herman Feldman. Responsibility of individual employers; forward steps taken by some industries and public utilities; control over the business cycle; incentive insurance. *American Labor Legislation Review*, Mar. 1926, pp. 47-56. Index no. 658.313.

### Results of the Adoption of the Eight-hour Day

Edgard Milhaud. This survey deals with the effect of the eight-hour working day on the workers themselves, with particular reference to their productive capacity and actual output. Information is drawn from Czecho-Slovakia, England, France, Switzerland, Lithuania, Belgium, United States. The general conclusion is that the shortening of the work day to eight hours has helped the moral, social and intellectual progress of the workers, has promoted technical progress in processes, equipment and organization, and has led to a more economical and effective use of productive powers of workers. *International Labour Review*, Feb. 1926, pp. 175-210. Index no. 331.81.

### Statistical Work of the National Government

Lawrence F. Schmeckebier. Johns Hopkins Press, Baltimore. 574 pp. $5. This volume is a study in the performance of the activities of the United States Government. Its purpose is to make known what the national government has done and is doing in the way of collecting and publishing information of a statistical character. Much of the information is of value to manufacturers, as for example, the sections on: Labor and Wages; Immigrants and Emigrants; Production of Minerals; Production of Manufactured Articles; Surveys of Industries; and Prices. Index no. 311.

### Workshops of German Machine Tool Builders

G. Schlesinger. Heavy machine tool plants and smaller machine plants; the growth and development of typical concerns in each field, their plants and equipment, products and general manufacturing methods and policies. *Werkstattstechnik*, Mar. 1, 1926, pp. 129-175. Illus. Index no. 338.4.

### World Developments in the Cotton Industry

Louis Bader. New York University Press, New York. 187 pp. $3. This book gives a brief survey of the significant tendencies in the cotton piece goods industry since 1909. Other countries are beginning to raise cotton in such quantities as to threaten the supremacy of the South as the leading cotton producer. Manufacturers of cotton goods are finding it impossible to sell all their mills can produce. Most of the older manufacturing countries are suffering heavy financial losses in the operation of cotton mills. The author surveys the economic factors and tendencies which have brought about this unfortunate situation, and declares that the cotton industry is in need of intelligent regulation by competent leadership from within the industry, but with supervision by proper governmental agency. Index no. 677:33.

## General

### Mechanical Engineering Curriculum

John Lyle Harrington. Summary of replies to a questionnaire sent to 500 members of the A. S. M. E. indicating the need for particularly sound training in all subjects given, and for more cultural and elementary scientific subjects in the usual four-year course. *Mechanical Engineering*, Mar. 1926, pp. 201-4. Index no. 607.

### Psychology of Vocational Adjustment

Harry Dexter Kitson. J. P. Lippincott Co., Philadelphia. 273 pp. $3. This book is designed to: (1) Point out the psychological problem involved in choosing a vocation and becoming proficient therein; (2) describe the attempts that have been made for their solution; (3) suggest and illustrate psychological methods that may be employed in the exploration of the field. Index no. 374-1.

# New Industrial Equipment

### Crawler Loader

One man machine to handle about 140 tons of stone, sand and like materials per hour. Constructed on a unit system—elevator, chassis, power plant, and crawler—for easy inspection and repair. Ample bearings and good lubrication by means of Alemite fittings or grease cups. Starting, turning and stopping all controlled by two hand levers, elevator by a separate lever. Lever clutch automatically disengages when the machine is reversed.

Buckets of special design with reinforced edges, closely spaced on chain to permit lower operating speed of elevator. Swiveled chute at head of elevator controlled from operator's platform and can be turned through an angle of 180 deg. Chassis of sturdy construction. Gasoline power unit of 30 hp. at 1200 r.p.m., equipped with governor, or with electric motor drive equipment.

Truck transmission has three speeds giving a speed of 33 or 66 ft. per min. in the forward direction, and 29 ft. per min. in the reverse. Machinery housing partially filled with oil encloses all driving and controlling mechanisms. Chain drives are of special wear-resisting construction. Self-cleaning crawler traction tread. Large rollers keep bearing up out of dirt. Made by Link-Belt Co. Index no. 621.875.

### Electric Soldering Iron

The General Electric Co. is now marketing a light, rod-heating soldering iron in standard sizes ranging from ½ in. to 1¼ in. Power consumption ranges from 70 watts for the smaller iron for light and intermittent use to 350 watts for the larger size on heavy duty.

Irons for heavy duty have radiating shields to maintain them at correct operating temperatures when temporarily not in use. A special handle from a steel rod provides a rigid connection between the handle and tip and prevents conducting of heat to handle. Instead of mica, the heating unit has a highly compressed insulating powder which is a good heat conductor and will withstand temperatures of more than 2000 deg. fahr. Standard lead and connection plug provided. Construction simple; parts few and easily replaceable. Index no. 621.7923.

### Industrial Trailer

Fifth-wheel steer type of trailer, used behind either gasoline or electric tractors. Platform 3 ft. by 6 ft.; platform height 15½ in. Frame built up of T-iron shapes. Wheels of semi-steel 12 in. in diameter with roller bearings and Alemite fittings. Also equipped with Bassic type Ruboid wheels or press-on type automotive tires, when desired. Provided with one set of pipe racks. Made by Crescent Truck Co. Index no. 658.281.

### Lead-Coated Economizers

To withstand high-pressures, resist corrosion, cut down soot deposits, and obtain the maximum heating surface in the minimum space the B. F. Sturtevant Co. have developed and put on the market a lead-coated, extended-surface economizer; known as type Y, to heat boiler feed water. Steel extension discs are shrunk on by a special process to insure maximum heat transfer.

Economizers are built with a minimum number of joints and are constructed in sections before shipment. Sections are assembled by 180 deg. bends and supported on steel angle framework enclosed in a thoroughly insulated casing. Easily taken apart and cleaned. Soot blower attachments provide for removal of deposit on tubes. Gas passages are staggered and proportioned for rapid passage with greatest economy of power to drive fan. Water flow is rapid to avoid scale deposit and counter to gas flow for greatest heat absorption. Index no. 621.1972

### Line Shaft Bearing

Box for replacement of bearings, size for size. Split for easy installation and fits any hanger. Helically wound roller bearings at each end. Center section plain and narrowed down to fit hangers with the smallest dimensions. Box built in two sections, lower part forming two-thirds and the top one-third, thus bringing joint well above oil level. Held together by four bolts. Bosses staggered to prevent improper fitting. Lubricant requires changing only once in three or four months. Shows savings as high as 15 per cent of the total power bill. Made at present in five sizes: 1 7/16, 1 15/16, 2 3 16, 2 7 16, 2 15 16 in. Manufactured by Hyatt Roller Bearing Co. Index no. 621.822.

### Motor-Driven $CO_2$ Recorder

The Republic Flow Meters Co. have put on the market a $CO_2$ recorder which is operated by motor and pump instead of by water power. The entire mechanism is immersed in oil, reducing wear and eliminating corrosion present in water operated recorders. The case is thoroughly dust proof, the only opening being on the top, closed by a tight cover.

Power consumption is very low. The only other expense is for 2 gal. of machine lubricating oil changed every 6 months to one year, and a 3-gal. solution requiring 12 lb. of dry potash and changed every 4 to 6 months. Gases pass through brass tubing, the pump, more brass tubing, into a measuring chamber, through the potash chamber, and into a final measuring chamber. These are all immersed in the same oil, or are in contact with the oil chamber, and hence all temperature irregularities are removed.

Operating parts are of steel, hardened and polished. Brass bearings and Bakelite or fibre gears, with all moving parts except the motor immersed in oil, provide long life and smooth, low-friction running. The recording dial is arranged for best visibility. Index no. 621.1977

### Panelboard for Industrial Use

A new line of industrial panelboards for the control of lighting systems in offices and factories is announced by the Westinghouse Electric and Manufacturing Co. These panelboards are made in sizes supplying from 4 to 32 circuits and in capacities ranging from 30 to 400 amperes.

The new panelboards are constructed with two doors, one within the other. The smaller door, giving access to the switch compartment, has a snap catch and may be opened by anyone. For safety, the larger door, opening into the fuses, is equipped with a Yale lock so that only authorized persons may open it. Panelboards are built up in unit construction, with eight single-pole or double-pole switches. These units may be easily removed from the front of the panelboard, making inspection and replacement easy.

The cabinet fronts of these panelboards are equipped with the Westinghouse standard trim clamp for mounting the trim on the box. This clamp permits easy adjustment of the panelboard trim when the box has been set up out of plumb. The trim clamp allows an adjustment up to ¾ in. in depth and a lateral adjustment of 3.4 in. Index no. 621.3283

### Portable Power Pipe Threader

The Oster Manufacturing Co. are now manufacturing a power-driven pipe threader made of aluminum alloy and weighing only 150 lb. It is portable as a unit, without the removal of any parts.

Power is furnished by a ½ hp. Universal reversible motor which speeds up on the smaller sizes of pipe, giving the outfit a greater production capacity. Motor can be run off any 110 or 115-volt lighting circuit, d. c. or a. c., single phase and of any cycles from 25 to 60.

The machine will drive nearly all die stocks and pipe cutters up to 2 in. capacity. With special auxiliary drive shaft, geared die stocks and cutters up to 6 in. capacity can be driven. The machine can be used to screw on fittings with a pipe wrench mounted in its driving arms.

Pipe is held in a three-jawed, self-centering chuck and the tools are turned by the driving arms. Self-centering universal guides in the rear of the machine assist the front chuck in centering long lengths of pipe. Machine is only 18⅛ in. high, 14½ in. wide and 30⅛ in. long. Index no. 621.944

### Resistance Welders

Two automatic machine welders, one for circular seams and the other for circular seams, are now manufactured by the General Electric Co. These welders consist of a framework for holding the work, a transformer for supplying current to the electrodes, movable electrode wheels and necessary control. Particularly designed for welding the seams of light metal containers such as ice cream cans, drums, etc., and are suitable only for making lap joints with relatively thin metal. Absence of fumes and open arcs makes the use of masks unnecessary. Operators require no special welding training.

Welding speed varies from approximately 20 in. to 100 in. per min., depending on the nature and thickness of the material to be welded. A total thickness of ¼ in. may be accommodated. Index no. 621.7923.

### Self-Lowering Governor-Controlled Jack

Important feature is control of lowering speed, which insures safety, eliminates shocks, and reduces wear. When two or more jacks are used under a load the uniform lowering speed eliminates tipping or uneven position of load. Governor control permits jacks to be slowed down or stopped instantly at any point without shock or strain. Standard cannot turn and slip out from under load. A holding clutch prevents a "sink-back."

Single, 3-position safety pawl on lever socket regulates operation up, neutral, or down without load.

Lock holds load and also acts as brake when lowering. Over-extending is prevented by a stop. Drop forged steel top. A one-piece shell holds all parts into one integral working unit. High factor of safety. Capacities range from 15 to 50 tons, raises from 15¼ to 23½ in., heights of jacks from 28 to 36 in., and weights from 150 to 290 lb. Made by the Duff Manufacturing Co. Index no. 621.869

### Static Condensers for Motors

Made by the Westinghouse Electric and Manufacturing Co. for motor circuits of 220, 440 and 550 volts, 2 and 3 phase. Condensers consist of insulation enclosed in a sheet metal container and a porcelain terminal housing arranged for conduit connections.

Advantages are: Losses of less than one-half per cent regardless of kva. rating; power factor correction at or very near the source; improvement of voltage regulation at motor or on feeders due to reduced line current and flexible localized form of correction. May be changed from one motor to another. Can be connected at the motor side and switched on and off with the motor without additional attention. Sizes ½, 1, 2½, and 5 kva. units. Index no. 621.315.

### Traffic Spots

Brass caps made in two diameters, 3 in. and 4½ in., for traffic divisional lines. Permanent, non-corrosive, highly visible, easily inserted and require no upkeep. Small sized shown at 1.41 centers, large size at 16' 2 in. centers. Can be used in any type of pavement. Applied in manufacturing plants to guide traffic or to indicate safety lines, truck stops and rates of truck speed. Made by Bridgeport Brass Co. Index no. 658.283.

# News of Manufacturing Industries

## The Month in Brief

**American Can Co.**—The directors on March 30 declared a quarterly dividend of 50 cents per share on the new $61,849,950 common stock, par $25, payable May 15 to holders of record April 30. This is at the rate of $12 per annum on the old $41,-233,300 common stock outstanding prior to the issuance in March of four new $25 par value shares in exchange for each common share of $100 par value and the payment of a 50 per cent stock dividend. Record of dividends paid on the old common stock follows: 1¼ per cent quarterly from Feb. 1923 to Feb. 1926 inclusive, and in addition an extra of 1 per cent on Feb. 15, 1924, an extra of 2 per cent on Feb. 16, 1925, and an extra of 3 per cent on Feb. 15, 1926. A 50 per cent stock dividend was also paid on the old common stock last month.

**American Engineering & Sales Corporation** has been recently organized to carry on selling, engineering, and handling import and export business. Walter N. Polakov is president.

**American Glue Co.—**

| *Calendar Years* | 1925 | 1924 |
|---|---|---|
| Net after all expenses | $ 982,997 | $ 687,229 |
| Dividends received | 97,411 | 36,611 |
| Interest on notes rec., etc. | 8,518 | 192,918 |
| Total income | $1,088,926 | $ 916,758 |
| Depreciation | 241,506 | 213,964 |
| Interest and discount on notes payable, etc. | 300,031 | 294,613 |
| Federal income and profit taxes | 70,000 | 55,000 |
| Provision for claims | 33,300 | ..... |
| Reserve for contingencies | 25,000 | ..... |
| Preferred dividends (8%) | 110,632 | 110,632 |
| Common dividends (cash) | ..... | ..... |
| Balance, surplus | $ 308,457 | $ 242,550 |
| Previous surplus | 1,124,422 | 881,872 |
| Profit and loss surplus | $1,432,879 | $1,124,422 |

**American Multigraph Co. (& Subs.).—**

*Consolidated Income and Profit and Loss Account for Years Ending*

| | 1925 | 1924 |
|---|---|---|
| Sales | $3,944,627 | $4,412,494 |
| Operating profit | 490,313 | 432,315 |
| Depreciation | 69,192 | 64,774 |
| Taxes | 81,691 | 84,545 |
| Net operating profit | $ 339,430 | $ 282,990 |
| Other income | 73,719 | 70,204 |
| Gross income | $ 413,148 | $ 353,200 |
| Provision for income tax | 40,634 | 42,232 |
| Interest and discount on notes | ..... | ..... |
| Other charges | 70,596 | 66,786 |
| Dividends on preferred stock | 15,435 | 27,216 |
| Dividends on common stock | 183,309 | 190,536 |
| Amortization of cost of patents | 11,900 | 40,000 |
| Premium, etc., for redemption of preferred stock | 5,948 | ..... |
| Balance | $ 85,327 | def$13,571 |
| Previous surplus | 928,223 | 941,794 |
| Profit and loss surplus Dec. 31 | $1,013,550 | $ 928,223 |

**American Radiator Co. & Subs.—**

| *Calendar Years* | 1925 | 1924 |
|---|---|---|
| [1] Profit | $13,196,434 | $12,877,554 |
| Other income | 925,045 | 438,469 |
| Total income | $14,121,479 | $13,316,023 |
| Interest paid and exchange | 254,666 | 184,196 |
| Pension fund, etc. | 206,585 | 201,630 |
| Depreciation and depletion | 2,026,627 | 1,776,469 |
| Net profit | $11,633,602 | $11,153,728 |
| Preferred dividends | 485,798 | 486,332 |
| Common dividends | $ 4,969,991 | $ 3,313,496 |
| Surplus | $ 6,177,813 | $ 7,353,900 |
| Profit and loss surplus | 24,879,830 | [3] 18,702,017 |

[1] Total consolidated profit from operations of all companies after deducting all ordinary and necessary expenses and reserve for estimated Federal taxes, but before deducting the annual provision for pension and benefit fund and depreciation and depletion of properties. [2] Includes preferred dividends of subsidiary companies. [3] After deducting a 50% stock dividend amounting to $10,354,675 on common stock.

**American Steel and Wire.**—Contract was let at the end of March for erection of a continuous billet and rod mill at the South Works, Worcester, Mass., at an estimated cost of more than $1,000,000.

**American Tank Car Corporation.**—A decrease in net income of $43,042 under that of 1924 is reported by the General American Tank Car Corporation for 1925. Earnings in 1925 were $2,003,956, against $2,046,998 in 1924. This was equivalent, after preferred dividends, last year to $5.38 on average number of common shares outstanding during the year and to $4.63 a share on 303,570 shares outstanding at the end of the year. In 1924 the figure was $5.62 a share on 252,872 outstanding shares.

**Armour and Company.**—Fourteen thousand employees of Armour & Co. plants throughout the country have received group insurance under a plan devised by themselves through the Plant Conference Board, on which the workers and management are equally represented. The company gave its approval by signing a contract with the Metropolitan Life Insurance Company providing about $12,000,000 life insurance, as well as health and accident protection for the workers. As more than 13,000 employees outside the plants are already insured for $27,730,000, the total for the Armour personnel is now about $40,000,000.

**Atlantic Refining Company.**—Gross income of the Atlantic Refining Company, a former Standard Oil unit, for 1925, was the second largest reported for any year in its history. Net profits, after all deductions and preferred dividend requirements, were the largest since 1920. The detailed earnings statement showed gross income of $137,849,719 from operations, against $124,-283,374 reported in 1924. After crediting other income, allowing for all deductions, including reserves for taxes, depreciation and depletion, and preferred dividends, the company reported a balance of $5,766,099, equal to $11.53 a share earned on the common stock of $100 par. In 1924 the company reported net income of $3,298,373 for the common stock, or $6.58 a share. In 1923 the company reported net profits of $835,634, which were insufficient for preferred dividend requirements.

**Babcock & Wilcox Co.—**

| *Calendar Years* | 1925 | 1924 |
|---|---|---|
| Gross profits | $1,102,974 | $3,447,143 |
| Other income | 852,677 | 906,609 |
| Total income | $1,955,651 | $4,353,752 |
| Depreciation, etc. | 414,900 | 528,685 |
| Federal taxes | 95,000 | 425,000 |
| Loss on sale of Barberton cottages | 3,486 | ..... |
| Dividends paid | (3½%) 700,000 | (7) 1,400,000 |
| Dividends declared payable Jan. 2 and April 1 | (3½) 700,000 | (6½) 1,300,000 |
| Surplus | $ 42,264 | $ 700,068 |
| Profit and loss surplus | 5,805,733 | 5,763,468 |

Unfilled orders at Dec. 31, 1925, amounted to $8,112,984 as compared with $7,747,133 at Dec. 31, 1924, and $14,417,526 on Dec. 31, 1923.

**Baldwin Locomotive Works.**—The company has received an order from the Pennsylvania Railroad for 175 mountain type locomotives, the total value of which amounts to about $12,000,000.

**W. A. Baum Co. Inc.**—H. N. Eaton, formerly of the Aeronautic Instrument Section, U. S. Bureau of Standards, on April 1 took up the duties of research engineer in the development of surgical instruments and equipment.

**Botany Consolidated Mills, Inc.**—The annual report of the Botany Consolidated Mills, Inc., for 1925, shows net income of $992,983 after all operating expenses, but before deductions of interest on bonds of the parent company. After allowing for interest, and net income applicable to minority stockholders, the company reported a balance of $398,100 available for dividend payments. A total of $400,000 was paid in dividends last year.

**Brunswick-Balke-Collender Company.**—The Brunswick-Balke-Collender Company reports a net loss of $720,512 for the year ended Dec. 31, 1925, after all charges. This compares with a net profit of $2,801,-723 for the year before.

**Edward G. Budd Manufacturing Company** has acquired 49 per cent of the capital stock of the newly organized Ambi-Budd Presswerke, G. M. B. H., of Berlin. This concern has been organized to manufacture automobile bodies and accessories. It is expected that immediate construction of new plants will begin, to cost approximately 5,000,000 marks, thus leaving a working capital of 2,500,000 marks.

**Bullard Machine Tool Co.**—Payment of the preferred stock, which has been called for redemption on May 19 at 107½ and dividends will be made at the First National Bank of Bridgeport, Conn.

**Burroughs Adding Machine Co., Detroit.**—The annual report for 1925, issued March 31, shows a net profit of $5,043,518,

*(Continued on page 382)*

*"We never know how **little** we make (or save), until we know how **much** we waste"*

# WHAT IS OUR INDUSTRIAL WASTE BILL?

## The Part of Management and Labor in Waste Elimination

Industrial Waste, **for which Management and Labor are responsible,** and which they could **eliminate** if they would **get together,** is shown in the following table (in which waste due to "outside contacts" is not considered) —

| | Waste for Which Management and Labor are Responsible | Value of Products (1923 Census) | Amount of Waste |
|---|---|---|---|
| Metal Trades | 25.8% | $14,190,690,000 | $ 3,661,198,020 |
| Textile | 29.4% | 8,308,469,000 | 2,442,689,886 |
| Boot and Shoe | 35.1% | 1,137,381,000 | 399,220,731 |
| Building Construction | 45.6% | 6,000,000,000 (3) | 2,736,000,000 |
| Printing | 52.6% | 2,021,356,000 | 1,063,233,256 |
| Men's Clothing | 58.8% | 1,566,468,000 | 921,083,184 |
| Total | 33.8% (1) | $33,224,364,000 | $11,223,425,077 |
| Mines and Quarries | 50.0% (2) | 5,998,800,000 | 2,999,400,000 |
| Total | 36.0% | $39,223,164,000 | $14,222,825,077 |

(1) Waste factors in six industries listed, taken from report, "Waste in Industry," of the Committee on Elimination of Waste in Industry, appointed by Herbert Hoover in 1921, on which Committee Mr. Knoeppel was a member.
(2) Estimate based on a study of Chapter XII, "Natural Resources," of the book, "The Tragedy of Waste," by Stuart Chase.
(3) From last annual report of the United States Department of Commerce.

Manufacturing and mining had a value of products of $66,554,798,000 in 1923. A waste factor of 36%, based on the seven industries listed above, would mean an annual waste bill of $23,959,727,280.

"But," says a reader, "such a figure is absurd."

The answer to this in the language of a friend is—"Tell him to write his own ticket."

Discounting the waste factor of 36% by one-half would give us *an annual waste bill of $11,979,863,640,* covering manufacturing and mining, for which Management and Labor are responsible.

**This is 35 times greater than the tax reduction recently approved by President Coolidge, the difference representing a tax which Management and Labor really impose on themselves by their failure to get together on the only common ground there is — that of WASTE ELIMINATION.**

We are advocating three things in our efforts to bring Management and Labor together on this common ground—

1. The establishment of a "WASTE ELIMINATION WEEK" in our plants, so that the **rank and file of our employees may be informed** as regards what waste is, its kinds and extent, and its effect on sales, costs, earnings, and **particularly on salaries and wages.**
2. The development of a plan for making Waste Elimination as **regular a part of business procedure** as that of controlling materials, watching credits, and **checking the bank balance.**
3. **The sharing of the savings made through Waste Elimination with those employees who help effect these savings.**

Why not arrange for a personal conference, without obligation, at which time the matter of the establishment of a "WASTE ELIMINATION WEEK," and the development of a permanent plan for Waste Elimination on the principle of "savings sharing", can be fully and intelligently discussed?

WASTE ELIMINATORS
INCORPORATED
C. E. KNOEPPEL, *Managing Director*
PARK SQUARE BUILDING BOSTON, MASSACHUSETTS
*A Division of Bigelow, Kent, Willard & Co., Inc.*

# Can You Afford Dark, Grimy Walls?

GRIME is the thief that steals your light, cuts factory production and shortens your working day.

Fight grime with Vorcolite, the finest, richest, inside flat white especially compounded for gun application.

Vorcolited walls shed a soft diffused luster without glaring high lights or blending shadows. Men see better, work faster, hold their jobs longer. The

## VORTEX Painting Method

*used only in the maintenance painting of large surfaces*

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**Paint Gun is Loaned—** The use of this superfine paint is made especially economical by the loan of our high-speed Vortex Painter equipment to use without cost in applying Vorcolite. The Vortex Painter, employing the exclusive principle of "paint confined in a cone of air" applies paint faster and with minimum loss.

**Lowest Labor Costs—** By using your own unskilled labor and the Vortex equipment, you paint at a labor cost of less than ten per cent of the total painting bill and get a better job.

**One Application Suffices,** being equal to two or more brush coats in covering value and light reflection.

**Little Scaffolding** is needed as extension tubes of different lengths reach all ordinary wall and ceiling heights.

**Order at Our Risk—** If a trial does not please you, reship unused material for credit.

*Scores of America's largest concerns rely regularly on Vorcolite and the Vortex Method for maintenance painting. Use the coupon as a step toward estimate.*

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**1982 West 77th St. - Cleveland, Ohio**

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We are interested in Vortex Painting for work of
approximately ..... square feet.
Interior or exterior ..... Color .....
Name .....
Address .....
Attention of .....

V-16


equivalent to $6.90 a share on the 600,000 shares of non-par value stock, as compared with $4,525,018, or $5.87 a share in 1924. Gross profits were $12,164,920, including $11,381,164 from sales and $783,756 from other sources, from which deductions have been made of $6,369,402 for expenses and $752,000 for U. S. income taxes.

President Standish Backus in commenting upon the report says: "The close of a most successful year and the opening of a new one finds Burroughs expanding its domestic and foreign activities—particularly with regard to the new Burroughs portable machine."

**Canadian International Paper Company.**— Approximately 2000 square miles of timber limits have been purchased from the Province of Quebec by the Canadian International Paper Company, to be drawn upon by the company's Kipawa mill at Temiskaming, which was recently enlarged from a capacity of 50,000 to 80,000 tons a year of bleached white sulphite pulp.

About 1200 square miles of these limits are in the upper Ottawa district, directly tributary to the Kipawa mill, and the acquisition of them gives the company a total of 3700 square miles tributary to Kipawa. The extended territories almost make possible a further expansion of the mill to a capacity of 160,000 tons of bleached white sulphite pulp a year, as the demand increases. This product is used extensively in the manufacture of rayon, the increasing use of which has necessitated an increase in the production of the pulp.

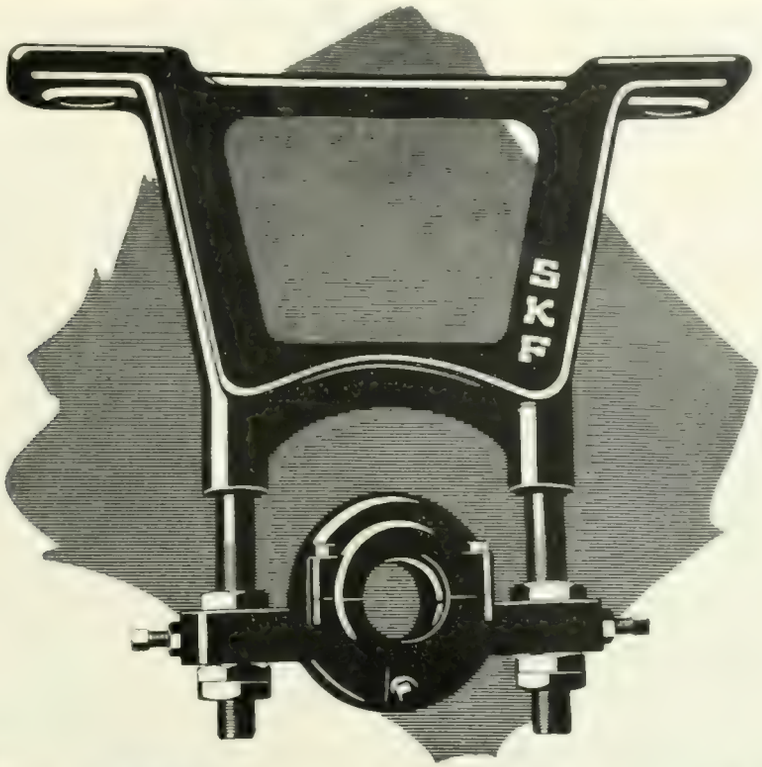
The balance of the 2000 miles just purchased lie in the Gatineau watershed, just tributary to the new newsprint mill the company recently launched at West Templeton, near the mouth of the Gatineau River. This mill is to have an initial capacity of 450 tons of newsprint a day, and the acquisition of these woodlands will facilitate an extension of the mill when necessary.

**Chicago Great Western Railroad Co.**— The Oelwein shops made a record of 280 days without reportable injury to any employee.

**Clark Tructractor Company.**—Eugene B. Clark, founder of the company, has recently published a booklet under the title, "Clark Theory of Labor Economy." Briefly, the theory is: The manufacturer must reduce to the minimum the number of unskilled employees, and must increase to the maximum the productivity of those he must retain. The booklet goes on to say that the way to increase productivity of unskilled workmen is to provide them with high-class tools.

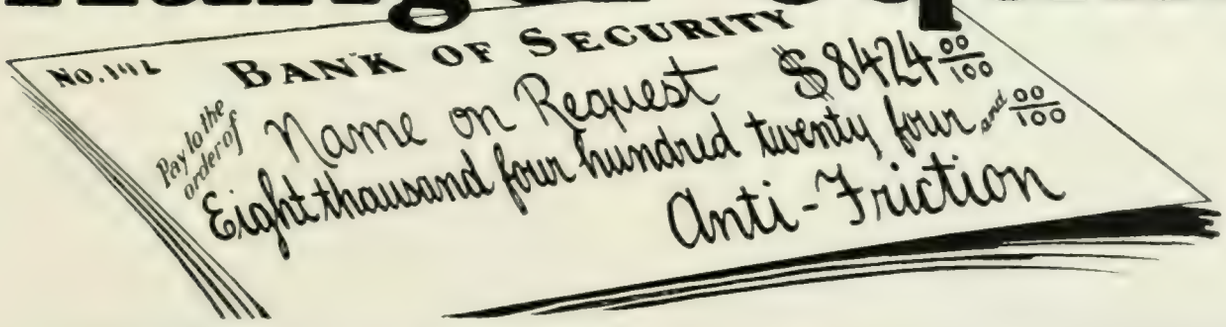
**Continental Baking Corporation.**—The companies owned and controlled by this corporation now operate 103 bakeries located in 81 cities. During 1925 they pro-

*(Continued on page 386)*




**SKF**
*Certified Campaign*
[illegible] is substantiated by an [illegible] may be obtained upon request.

# 500 Times this Hanger equals




A MIDDLE WEST manufacturer had been carrying Friction on his pay roll for years. He didn't know it, of course. Friction doesn't work that way. But Friction was taking a heavy toll through every plain bearing hanger in this plant.

Then Skayef Self-Aligning Ball Bearing Hangers were installed—just a few at first, eventually over 500 of them. The result was a saving of $8,424.00 a year, or 25% in power costs alone!

The moral is that many a manufacturer who is operating on plain bearing line shafting is paying for Skayef anti-friction equipment many times over—and doesn't know it.

It will pay YOU to consult a Skayef engineer today.

The SKAYEF BALL BEARING COMPANY, 165 Broadway, New York

BALL BEARING

# SKAYEF HANGERS

POST HANGERS, PILLOW BLOCKS SKF Puts the Right Bearing in the Right Place AND TRANSMISSION APPLIANCES

Standard Steel Ring Platform Truck. Low Steel Lift Truck [illegible] of both steel and [illegible] of service. The wheels wear down or wabble.

# Hidden Values and Lift Trucks

A drop forge company needed a new furnace-considered two makes—and purchased a unit $2,500 higher in price. Hidden values covered up with paint, mortar, brick, save them $1,600 in re-arching costs alone every three years.

They needed lift trucks, and again getting down to naked values they purchased Stuebings for the same reasons that made it advisable for the Wrisley Company to buy five Stuebings in preference to ten lift trucks.

Nothing is too good for you. The stronger, heavier, more efficient construction is essential always. Only by building the BEST way rather than the cheapest—the RIGHT way instead of the easiest, has Stuebing-Cowan gained the full confidence of men who look for the hidden values. In addition, Stuebing-Cowan give a degree of service, protection, and interest, whose cash values are very real.

You will find Stuebing-Cowan lift trucks are built like machines. Judge them as machines, for what the paint protects rather than covers up. Have you tried the K Model for hard lifting loads?

## The Stuebing-Cowan Co.

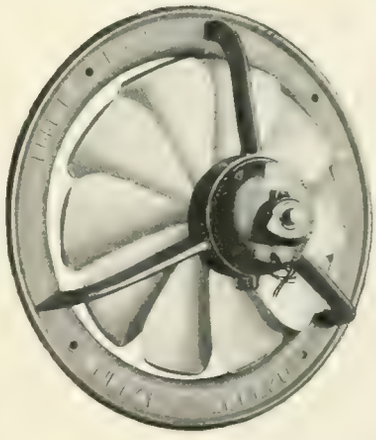
Cincinnati, O. Holyoke, Mass.

StueBing and COWAN

# Factory Ventilation is claiming more attention

Today, no factory is planned without preparation for ventilation. More and more the importance of keeping the workman physically fit is affecting the selection of equipment.

In hundreds of plants all over the world Buffalo-Carrier equipment is handling the heating and ventilating in a manner that leaves nothing to be desired.



Buffalo-Carrier Equipment may be used for scores of jobs—to keep the temperature of a room (or plant) at any desired degree; to remove hot air from around ovens, draw off smoke, steam, fumes, gases, odors, remove chips, shavings and dust, cool molds, and many other things. If you have a ventilation problem let us make recommendations. There is no charge for this service.

## Buffalo Forge Company

Carrier Air Conditioning Company of America

141 MORTIMER ST. BUFFALO, N. Y.

IN CANADA: CANADIAN BLOWER AND FORGE COMPANY, Ltd. KITCHENER, ONTARIO


duced approximately 1,000,000,000 pounds of bread and 60,000,000 pounds of cake.

Results for year ended December 26, 1925, are:

| | |
|---|---|
| Net income available for interest, depreciation and income tax | $13,436,916 |
| Interest on funded debt and amortization of bond discount | 633,817 |
| Depreciation | 2,596,064 |
| Net income available for dividends and income tax | $10,207,035 |

Between January 1, 1925, and May 1, 1925, 61 bakeries were added to the business. Very few of these reflected any benefit of Continental management during the first six months of the year.

**Copper and Brass Research Association** estimates that the rate of copper consumption in the radio industry has more than doubled in the past two years and is now approximately 10,000,000 pounds a year. In 1924 the average weight of copper per set was 2½ pounds; in 1925, 4 pounds; at present it ranges from 6 to 10 pounds.

**Devoe & Reynolds Company, Inc.**, announces the sale of 5020 shares of its Class A common stock at $35 a share to nearly 500 employees. The shares were issued in two allotments, the first on Nov. 6 and the second on Jan. 15, and are to be delivered to the purchasers in November, 1927. Of the total number of shares offered, 1092 were purchased outright and the balance of 3928 on instalments of $5 down and a minimum of $2 per share per month. The sales were widely distributed, including more than 20 branches, the four factories of the company, the New York general offices and in Wadsworth, Howland & Co., Inc., the Boston subsidiary.

**Dodge Brothers, Inc.**—Edward C. Wilmer has assumed active charge of the affairs of Dodge Brothers, Inc., having been elected president to succeed Frederick J. Haynes, who is now chairman of the board.

**E. I. du Pont de Nemours and Company.**—Lammot du Pont has been elected president to succeed Irenee du Pont. The retiring president has been made vice chairman of the Board of Directors and Chairman of the Finance Committee. Lammot du Pont is the eighth member of the du Pont family to head the company since the business was founded in 1802. Pierre S. du Pont, the first of this trio, was in office from 1915 to 1919.

**Du Pont Rayon Co.**—The Company has filed a certificate at Dover, Del., increasing its authorized common stock from 125,000 shares (100,000 shares of voting stock and 25,000 shares non-voting) to 1,250,000 shares, of which 1,000,000 shares are voting stock and 250,000 are non-voting stock, no par value. The 100,000 shares of 8 per cent cumulative non-voting preferred stock (par $100) remain unchanged.

*(Continued on page 388)*

# *Grinding - and its Part in Motor Progress*

In 1905, the first Norton grinding machine was sold into the automobile industry. Grinding at that time was not a factor in machining operations. Today, many types of grinding machines perform hundreds of operations in this industry. Grinding departments of the great automobile plants are hives of production activity.

With the development of abrasives, grinding wheels and grinding machines has come the development step by step of the motor car. Precision with quantity production has been the goal. Comparison of the car of today and its cost with that of twenty years ago shows what grinding has helped to accomplish. Comparison of street traffic of twenty years ago with today tells a similar story.

The automobile is but one of many modern machines of general usefulness made possible by the help of the abrasive industry.

**Norton Company**
Worcester, Mass.

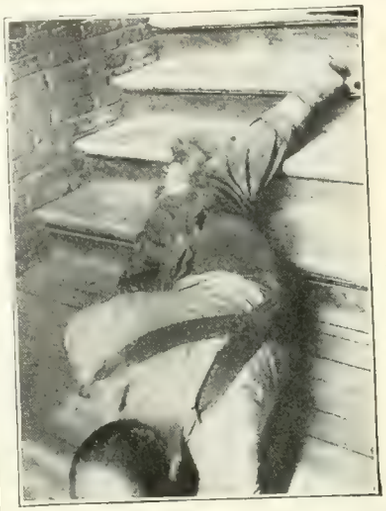
New York Chicago Detroit Philadelphia Pittsburgh
Boston Buffalo Cleveland
Akron Newark Niagara Falls, N. Y. Los Angeles, Cal.
Granville, Mass. Worcester, Mass.
Hamilton, Ont., La Corbeille, P. Q., Wesselman, Germany

# NORTON

**Grinding Wheels**
**Floors and Stair Treads**

NORTON

**Grinding Machines**
**Refractories**



# YOU PAY

## For Accidents Like This!

## PREVENT THEM

WITH

# FERALUN
*Anti-Slip Treads*

How many of the 6,000 deaths and 800,000 serious injuries each year due to falls occur in your plant? How much do they cost you in compensation or damage claims?

Most of this loss and suffering can be absolutely eliminated by use of anti-slip, wear-resisting, moisture-proof treads. An abrasive of almost diamond-hardness mixed with the molten metal at the time of casting prevents walkways from ever becoming slippery.

Installations have saved thousands of dollars to manufacturing plants.

*Write and ask us about them*

**AMERICAN ABRASIVE METALS CO.**
**48 Church Street, New York**

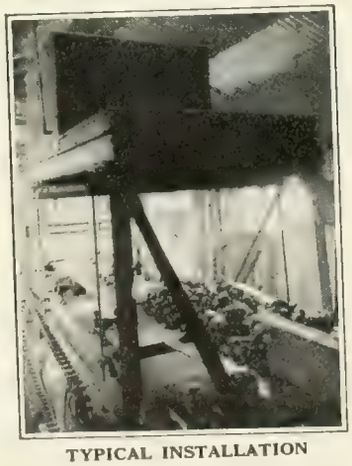
FERALUN BRONZALUN ALUMALUN CARBORUNDUM TILE

**SAVE TIME AND LABOR**

USE THE

# Merrick Conveyor Weightometer

Any material handled on a belt, bucket or pan conveyor fitted with **MERRICK WEIGHTOMETER** is automatically weighed as it moves along. The scale is always on the job—it makes no slips—it's honest—and its totals at the end of the day are accurate and they require no special attendant.



TYPICAL INSTALLATION

***Material being handled over Weightometers***

COAL
ORES (all kinds)
CEMENT
SHALE
CLINKER
ROCK
GYPSUM
FISH
FERTILIZER
PHOSPHATES
SAND
PAPER MILL PRODUCTS
HOG FUEL
SALT
ETC., ETC.

**MERRICK SCALE MANUFACTURING CO.**
**186 AUTUMN STREET, PASSAIC, NEW JERSEY**


**Durham Hosiery Company.**—Net profits of $87,618, after expenses, interest, depreciation, etc., is reported for 1925 by the Durham Hosiery Company, against $137,054 for 1924. Surplus in 1925, after preferred dividends, was $74,493.

**Eastman Kodak Company.**—Earnings of the Eastman Kodak Company during the fiscal year ended Dec. 31, 1925, were $18,467,113.93. The earnings in 1924 were $17,201,815.24.

The company paid dividends of $8 a share on common stock of no par value, the dividends totaling $16,231,640, against $16,267,400 the year before.

Surplus for the year is estimated at $1,751,731.93 after charging off depreciation and providing for dividends on common stock and four quarterly dividends of 1½ per cent on preferred. Preferred dividends total $369,942.

**Electric Storage Battery Company,** manufacturers of Exide Batteries, announces the appointment of H. B. Gay as vice president. He will continue to have charge of sales.

**Everett-Norfolk Knitting Company.**—Consolidation of several New Hampshire textile interests into the Everett-Norfolk Knitting Company, which will include what was formerly the Norfolk Knitting Mills Corporation of Norfolk, Va., and Littleton, the Everett Knitting Works and the Everett-Norfolk Paper Box Company of Lebanon, with a capitalization of $810,000, has been completed. The company will manufacture worsted jersey cloth, rayon fabrics and underwear.

**Fleischmann Company.**—Earnings of the Fleischmann Company for the first quarter of 1926 will show an increase over those for a like period in 1925 of from 40 per cent to 45 per cent, according to President Joseph Wilshire.

**Ford Motor Company.**—Total sales of over $11,000,000 were made in 1925 by the by-products division. Conversion of waste accounted for over one-third of this amount.

Seven surplus factories, located in Philadelphia, Cambridge, Mass., Dallas, Louisville, Memphis and Minneapolis have been placed on the market. They are valued at approximately $7,000,000, are typical Ford plants, having been erected by the Ford Company and have well located railroad facilities. Each is a complete manufacturing unit. The buildings are of reinforced concrete.

**Garl Signal Company** has been incorporated with capital of $100,000 to take over the good will, basic patents, and other assets of the Garl Electric Company. It will manufacture and market the Garl fire and police alarm signals for industrial plants and municipalities.

*(Continued on page 390)*

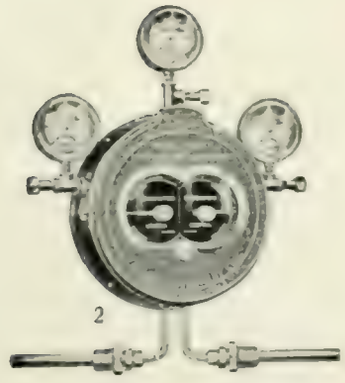
*James Watt studying the power of steam from the tea-kettle in the fireplace.*

# Are You Still in the James Watt Era?

NO matter what you manufacture, there must be some step in the process where temperature or pressure exercises a decisive control on your costs of doing business.

If you are guessing about it, you are still in the same position as the youth James Watt, before he had discovered what steam could do when properly harnessed.

Stop guessing—know! Use exact methods of temperature and pressure control throughout your process work, or in your power plant. The saving in the elimination of spoiled material and in lower cost production will amaze you!



*Tycos Dubl-Duty Temperature Regulator—automatic in action.*

*Tycos* indicating, recording and controlling instruments are the sixth sense of industry; the modern substitute for that instinct of the mastercraftsman of old which guides production through to the perfect product.

*Tycos* engineering service is at your disposal to study the particular needs of your industry. May we send you a booklet describing some of the special apparatus made for your business?

## *Taylor Instrument Companies*

Rochester, N. Y., U. S. A.

Manufacturing Distributors
in Great Britain
Short & Mason, Ltd., London

Canadian Plant
Tycos Building
Toronto

699

# *Tycos Temperature Instruments*

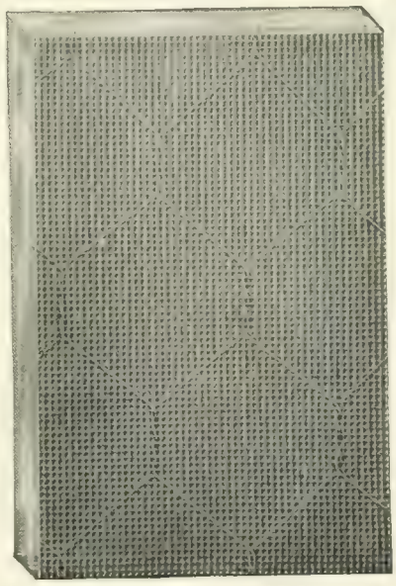
INDICATING · RECORDING · CONTROLLING

# Factrolite Wire Glass

For windows, this is the best type of glass to install.

Because it is scientifically designed especially for windows to eliminate the glare of the sun and afford uniform light distribution.

By using Factrolite it is possible to increase the light in a room 25 feet or more deep from 38 to 72 per cent as compared with clear glass.



*Made in both Plain and Wire Glass*

MISSISSIPPI GLASS COMPANY
MISSISSIPPI WIRE GLASS COMPANY

220 Fifth Avenue
New York

Chicago, Illinois — St. Louis, Missouri



# For oil burners

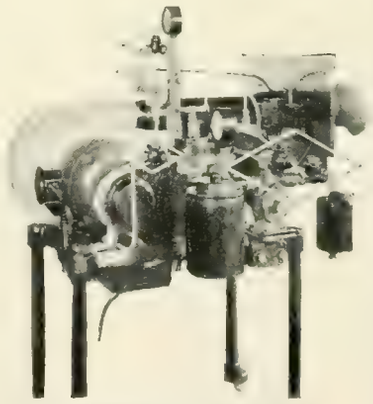
The successful automatic operation of the Rayfield Oil Burner is aided by the use of Jenkins Check Valves. The makers of this burner recognize the prompt and reliable check valve action which they obtain by standardizing on Jenkins.

Jenkins Renewable Discs insure leak-proof contact at the seat, at the same time taking up wear throughout the valve.

Manufacturers of many types of industrial equipment have found Jenkins Valves useful as vital parts of their products. Confer with our sales engineering department.

JENKINS BROS.

*80 White Street.....New York, N. Y.*
*524 Atlantic Avenue.....Boston, Mass.*
*133 No. Seventh Street.Philadelphia, Pa.*
*646 Washington Boulevard Chicago, Ill*
*JENKINS BROS., Limited*
*Montreal, Canada London, England*



*Rayfield Oil Burners equipped with Jenkins Check Valves, Fig. No. 552, 655 and 750.*

"Always marked with the Diamond"
Jenkins Valves
SINCE 1864


**General Electric Co.**—The annual report of the G-E Employees Securities Corp. shows that 24,272 employees of the General Electric Co. own bonds, an increase of 8 per cent over the total for 1294. The average holding is $760 as compared with $550 in 1924. The funds of the corporation are invested in the stocks and bonds of 94 public utility companies and according to the report "no default in interest or dividends has occurred in any since the organization of the corporation."

**General Motors Corporation.**—The number of stockholders at the close of the initial quarter of 1926 was 56,693, of which 33,916 hold common stock. This number is an increase of 5776 over the last quarter of 1925.

**B. F. Goodrich Company.**—The report of the B. F. Goodrich Company for 1925 shows net sales of $136,239,526, against $109,817,685 in 1924. After allowing for all expenses and reserves for depreciation, interest and taxes, and a special reserve of $4,000,000 to cover possible losses due to fluctuations in crude rubber prices, the company reported net profit of $12,744,447, against $8,822,504 in 1924. The net profit, after allowing for preferred dividends, was equal to $17.33 a share on the 601,560 shares of no par value common stock. This compares with $10.57 a share on 601,400 shares in 1924.

The consolidated income account for 1925 and 1924 follows:

| | 1925 | 1924 |
|---|---|---|
| Net sales | $136,239,526 | $109,817,685 |
| Manufacturing expense | 113,860,422 | 95,952,161 |
| Profit | $ 22,379,104 | $ 13,865,524 |
| Other income | 1,020,035 | 865,642 |
| Total income | $ 23,299,139 | $ 14,731,166 |
| Depreciation | 2,377,192 | 2,547,434 |
| Interest, etc. | 1,927,500 | 2,361,228 |
| Federal taxes | 2,350,000 | . . . . . |
| Reserve | [1] 4,000,000 | 1,000,000 |
| Net profit | $ 12,744,447 | $ 8,822,504 |
| Preferred dividends | 2,314,620 | 2,460,150 |
| Common dividends | 1,202,800 | . . |
| Surplus | $ 9,227,027 | $ 6,362,354 |
| Earned surplus | 24,770,124 | 17,609,966 |

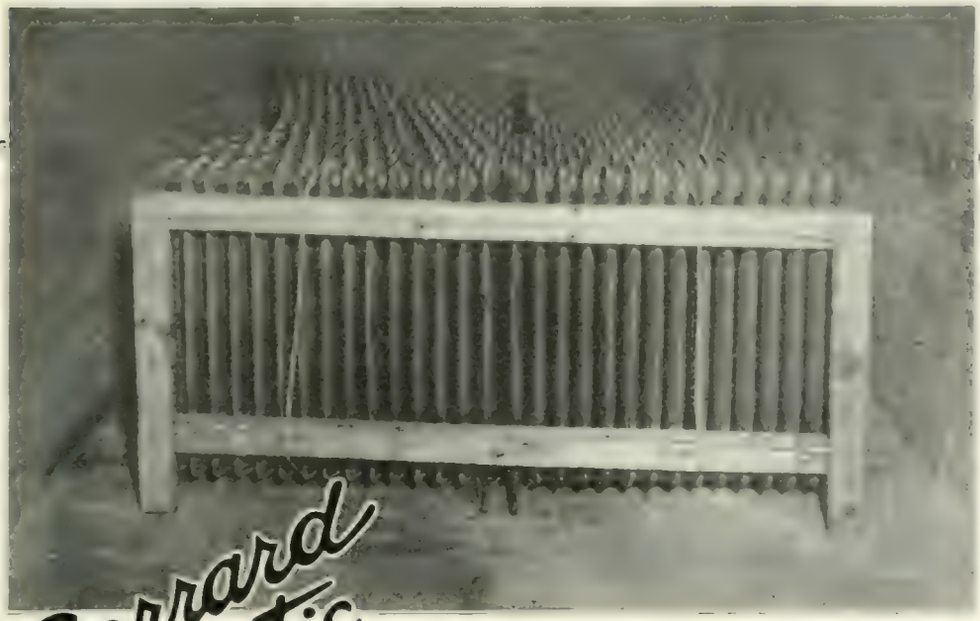
[1] Set up for contingencies and to cover possible losses due to fluctuation in prices of raw materials

**Goodyear Tire & Rubber Company.**—P. W. Litchfield has been elected president. He has been in the service of the Company for 25 years, having entered its employ in July 1900 in charge of production.

**Goulds Pumps, Inc.,** is the new corporate name, effective April, 1926, of the Goulds Manufacturing Company, of Seneca Falls, N. Y. This change is made for the reason that the Company now manufactures but one product, pumps, and wishes to link its product directly with its corporate name.

**Gulf Refining Company.**—A new oil tanker, the "Gulfcrest," has just been delivered to the Gulf Refining Company. It is the largest craft of its type in service

*(Continued on page 392)*



GERRARD Uni-Lastic STOWAGE

"The Tie That Binds"

Gerrard Uni-Lastic Stowage

## Stowing Radiators the Gerrard Way

Radiators are now insured against damage while enroute from shipper to consignee with Gerrard Uni-Lastic Stowage. The radiator manufacturers are saving money, the carriers are reducing claims and the consignees are "tickled to death".

### The Application

Uni-Lastic Stowage is quite easily applied to radiators by nesting half carloads between end gates and binding the unit into a compact mass with our round bands of 8 gauge steel. The bands are tightly tensioned and sealed by the Model "G" Little Giant Wire Tying Machine with "The Tie That Binds".

*Your copy of the new Gerrard Catalogue contains valuable packaging and shipping information. What is your address?*

### The Results

Gerrard Uni-Lastic Stowage does away with separating strips between the radiators as well as side bracing strips and dunnage is reduced from 600 lbs. to 175 lbs. The tight, secure nesting obtained eliminates chipping, while loading and unloading is easier and more rapid.

Uni-Lastic Stowage can be applied profitably to *your* car load shipments. May we show you how?

GERRARD WIRE TYING MACHINES CO.
1943 South 52nd Avenue :: :: CHICAGO, ILL.

# Working When It's Warm

— that's the point to remember! Rundle-Spence Vertico-Slant Fountains keep your employees *working* even when the weather is warm. Cool! Contented! Invigorated!

Besides, R-S Vertico-Slant Fountains enforce drinking sanitation—eliminate contagion that arises from lip-contact —and make drinking quick and convenient. They're "health bubblers" straight through.

The R-S line includes Sanitary Drinking Fountains, Bath and Plumbing Fixtures and Supplies. Write for illustrated catalog with complete information.

**RUNDLE-SPENCE MFG. CO.**

**62 Fourth Street** **Milwaukee, Wis.**

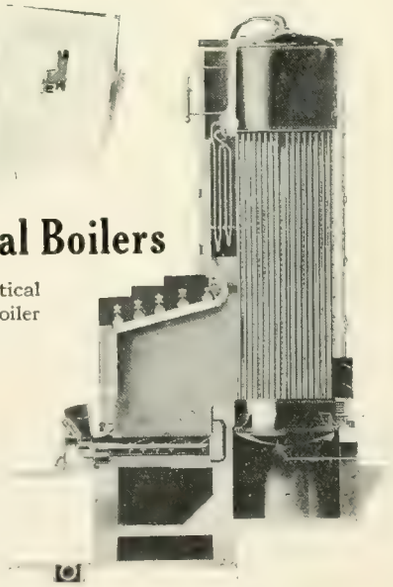
**RUNDLE-SPENCE**

# Superheaters for Vertical Boilers

Elesco superheaters may be installed in vertical water-tube boilers without disturbing the boiler setting except in very special cases.

Placement of the superheater in the correct location in a boiler is quite as essential as the choice of the superheater itself. Different arrangements of Elesco superheaters for vertical boilers are shown in the series of bulletins listed below.

Send the coupon with desired bulletins checked.



Elesco Superheater in a Wickes Vertical Boiler. This arrangement is covered in Bulletin T-13-Wickes sent on request

THE SUPERHEATER COMPANY

17 East 42nd Street NEW YORK — Peoples Gas Building CHICAGO

BULLETINS WANTED

☐ T-10—*Casey Hedges*
☐ T-10—*Erie City*
☐ T-10—*Ladd*
☐ T-13—*Wickes* Mfg. Ind.

*Name*.....

*Firm*.....*Position*.....

*Address*.....


in the United States, having a cargo capacity of 4,500,000 gallons and a deadweight tonnage, fully loaded, of 19,485 tons. She is rated as a 13,500 ton vessel and is Diesel engine driven.

**Hart, Schaffner & Marx.**—A bonus of $500 each was recently paid to about 150 clothing cutters laid off on account of slack business. The total settlement aggregated about $75,000, of which $50,000 was contributed by the clothing firm and the balance by 350 cutters who remained at work. Their contribution is in the form of a weekly deduction of part of their salary.

**R. Hoe & Co.**, printing press manufacturers, report net profit for 1925 of $3,734 after interest, depreciation and taxes, equivalent to 4 cents a share earned on 80,000 shares of no par class A stock. This compares with $729,880 in 1924, which if applied directly to the class A stock was equal to $9.12 a share and under the participating provisions to $5.04 a share on the class A and $2.04 a share on the 160,000 shares of no par common stock.

**Hyatt Roller Bearing Company** announces the appointment of Howard B. Jernee as sales manager of the Line Shaft Bearing Department.

**Illinois Steel Company.**—At the Joliet works 3000 employees recently completed a period of 116 days without a lost-time accident.

**Ingersoll-Rand Co.—**

| *Calendar Years* | 1925 | 1924 |
|---|---|---|
| Total income | $8,117,264 | $6,138,042 |
| Depreciation | 1,048,761 | 1,036,517 |
| Reserve for Federal taxes | 871,057 | 596,901 |
| Interest on bonds | 50,000 | 50,000 |
| Dividend on preferred stock (6%) | 151,518 | 151,518 |
| Balance, surplus | $5,995,927 | $4,303,106 |
| Previous surplus | 6,591,799 | 4,212,149 |
| Adjustments | *Dr*350,507 | ..... |
| Amount transferred to common stock | 2,886,756 | ..... |
| Total surplus | $9,350,463 | $8,515,255 |
| Common dividends: | | |
| Old stock (10%) | ..... | ..... |
| New stock (8%) | 1,923,802 | (8) 1,923,456 |
| In stock | ..... | ..... |
| Profit and loss, surplus | $7,426,661 | $6,591,799 |

**International Harvester Company,** in its report for 1925, shows a net profit of $19,171,240 after interest on loans, depreciation, special maintenance, etc., totaling $9,785,727. The 1924 balance was $55,121,169. In 1925, after preferred and common stock dividends of $9,357,470, the surplus was $64,934,938.

**International Paper Company.**—In its detailed report for 1925, the International Paper Company shows a net income of $1,571,281, available for common stock dividends after depreciation, interest, taxes, preferred dividends and reduction of contingency reserves.

The total revenue for the year was $8,212,383. Depreciation was $3,404,519; interest, $2,195,969; taxes, $61,593, and the contingency reserve, $1,000,000. Divi-

*(Continued on page 394)*

# From President to Superintendent

## —every executive indorses Calculagraph

# *Elapsed Time* Records

In thousands of industrial plants and factories throughout United States and in many foreign countries, Calculagraph is indorsed by executives because Calculagraph is an established factor of industrial economy.

Whether you are personally concerned with management, production, or cost accounting, Calculagraph is indispensable.

Calculagraph prints *on any style of time ticket* the automatically-computed total of working time elapsed on every job—for every man—and also the time of beginning and ending each job.

Let us send you our comprehensive booklet—*Elapsed Time Records*—containing interesting data on the uses of elapsed time in connection with your own work. Write for it to-day.

**The Calculagraph Company**

**50 Church Street Dept. 12 New York City**

CALCULAGRAPH

*The Elapsed Time Recorder*

**ECONOMY LIFTERS**

*Stackers—Tiering Machines — Portable or Stationary*

**Economy Engineering Co.**
3693 W. Van Buren St., Chicago
342 Madison Ave., New York

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MANAGEMENT AND ADMINISTRATION IN MANUFACTURING INDUSTRIES published monthly at Camden, N. J., for April 1, 1926.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared William J. Grange, who, having been duly sworn according to law, deposes and says that he is the Secretary of The Ronald Press Company, publishers of MANAGEMENT AND ADMINISTRATION IN MANUFACTURING INDUSTRIES, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—The Ronald Press Company, 15 E. 26th Street, New York City.
Editor—Leon P. Alford, 15 E. 26th Street, New York City.
Managing Editors—None.
Business Managers—None.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

The Management Publishing Corporation, 15 E. 26th Street, New York City, in which the following own 1 per cent or more of the stock: The Ronald Press Company, 15 E. 26th Street, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner, and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is: (This information is required from daily publications only.)

THE RONALD PRESS COMPANY,
(Signed) WILLIAM J. GRANGE, SECRETARY

Sworn to and subscribed before me this 25th day of March, 1926.
(Signed) EUGENE J. CLEARY.
(Seal.) (My commission expires March 30, 1927.)

dends of $1,979,019 were paid on the preferred stock. Surplus Dec. 31—including paid in surplus, $2,140,950, and that from Jan. 1, 1925, $18,144,986—was $21,857,217.

Assets for 1925 totaled $148,585,001. These included cash, $1,573,059; accounts receivable, $7,226,611; notes receivable, $989,489, and inventories, $23,255,232. Capital assets totaled $110,565,065. Total liabilities were $126,727,784. Current liabilities, including accounts and notes payable, $10,769,998, and dividends payable on the preferred stock, $548,025, were $11,318,023. Capital stock and surplus totaled $83,743,030.

**Jones & Loughlin Steel Corporation.**—Total shipments of steel products during 1925 increased 26.7 per cent over those of 1924. This rate of operation is somewhat higher than that which generally prevailed among other Pittsburgh producers. Net earnings of the corporation were $10.39 per share on the common stock. This compares with $8.20 for 1924.

**Milwaukee Electric Crane & Manufacturing Corporation** announces the appointment of A. H. Ellison as district representative of the New York territory.

**Morse Chain Company.**—Maurice Hart has been appointed manager of the Buffalo district and a new office has been opened in the Ellicott Square Building, Buffalo.

**National Association of Foremen.**—Third Annual Convention of the association will be held at Springfield, Ohio, Tuesday, May 25. The program will consist of four addresses in the morning, factory visits in the afternoon, and a banquet in the evening. Foremen from any industry are cordially invited to attend.

**National Biscuit Co.** announces that it has acquired the soft wheat mill of the National Milling Company at Toledo. The plant is credited with being the largest soft wheat mill in the world. It produced more than a million barrels of flour last year.

**National Carbon Company** has purchased the battery business of the Manhattan Electrical Supply Company with plants located at Jersey City and Ravenna, Ohio. The dry cells heretofore marketed under the trade-mark "Red Seal" will be manufactured and sold under the same trade-mark.

**Niles-Bement-Pond Company.**—The annual report of the Niles-Bement-Pond Company for 1925 shows a net loss of $799,519 after all deductions, against a net loss of $1,185,808 reported in 1924. The profit and loss surplus on Dec. 31, 1925, according to the balance sheet, aggregated $3,547,315, against $7,244,790 at the close of 1924.

**Packard Motor Car Company.**—The Packard Motor Car Company reports net

*(Continued on page 395)*

**Metal Sickness costs money**

Metal is sick when it is rusty. It needs "doctoring," such as painting, or an "operation," such as replacement. And, of course, there's the "doctor" bill.

That is eliminated by the use of BRASS pipe, COPPER sheet metal work, and BRASS or BRONZE hardware and lighting fixtures.

RUST never puts *them* on the sick list in plant, office, or home.

**COPPER & BRASS RESEARCH ASSOCIATION**
25 Broadway, New York

[illegible] Feb. 28. This is equivalent to $1.19 a share on the [illegible] cents a share, for the corresponding quarter [illegible]

**Pure Oil Company.**—A subscription of $[illegible] has been received by the Pure Oil Company for its recently announced savings and investment plan. Of the 5456 employees eligible, 4201, or more than 77 per cent, have subscribed, with an average subscription of $1032.

The plan provides for the purchase of the company's 6 per cent preferred stock over a four-year period by equal semi-monthly payments, the maximum subscription being an amount equal to the employee's yearly salary. Subscribers will receive 8 per cent on their total subscription from the start, and will pay 6 per cent on unpaid balance. They may withdraw the full amount of their payments and drop the plan at any time.

All subscribers who complete their payments for the four-year period will receive, in addition to their stock, a bonus of 25 per cent of their subscription. Thus, if all subscribers complete their payments, the company will pay a bonus from its treasury of $1,084,125.

**Remington Typewriter Co.—**

| Calendar Years | 1925 | 1924 |
|---|---|---|
| Net after taxes and depreciation | $2 [illegible] | $1 [illegible] |
| Interest | | [illegible] |
| Net earnings | $2 [illegible] | $1 [illegible] |
| 1st preferred dividends | [illegible] | [illegible] |
| 2d preferred dividends | 1 197 576 | [illegible] |
| Surplus | $ 817 601 | $ [illegible] |
| Prior year surplus | [illegible] | [illegible] |
| Adjustments applicable to previous years | | [illegible] |
| Total surplus | $6,700,554 | $5,882,952 |
| Less Treasury stock | | |
| Profit and loss surplus | $6,700,554 | $5,882,952 |

**Republic Iron & Steel Co.**—The company has sold to the Mahoning Valley Water Co., of Youngstown, O., its Commercial Water Co. property, arranging to secure from the purchaser a portion of its water needs. About 400 acres of land are involved in addition to an important dam site. A dam to replace one washed away a number of years ago will be erected, about 85 feet high and 400 feet long and creating a reservoir capable of delivery of five or more million gallons of water daily.

**Serv-El Corporation** has recently sold $5,000,000 issues of notes. The proceeds will be applied to expansion due to the reorganization of the Company and the purchase of a new Swedish refrigeration machine which will be marketed in the name of the Serv-El subsidiary, known as the Electrolux Serv-El Corporation.

(Continued on page [illegible])


# Mercury

{ This is No. 5 of a series }

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There is in nearly every manufacturing establishment one man whose duty it is to attend to the movement of materials and supplies.

It is his responsibility to see that raw materials are unloaded from cars and moved to storage—from storage to the point of first operation—trucked from operation to operation — and finally delivered in the form of finished goods to the shipping platform.

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**Singer Manufacturing Company.**—April 1 dividend of the Singer Manufacturing Company was the regular dividend on the common stock of $2.50 per share and an extra dividend of $33.50 per share.

**Standard Sanitary Mfg. Co.**—The company is the leading producer in the three lines of plumbing fixtures it manufactures, namely, enameled ware, vitreous china ware and brass. All these lines show an increase in production and sales. A further increase during 1926 is expected through the addition of the Pacific Sanitary Mfg. Co. plants and Baltimore works, which is now operating in a satisfactory manner. Over 1000 men are now employed at the Baltimore works, and are now turning out enameled ware equal in quality to that produced at the other plants. The new brass plant at Louisville, Ky., doubling previous capacity, is now completed and in full operation. The total number of shareholders has increased from 4828 to 6131. Of this number 4000 are employees and officers of the company, who own 241,374 shares of common stock, and 6134 shares of preferred stock.

**Tagliabue Manufacturing Company** has issued a booklet on recording instruments for manufacturing firms under the striking title, "Do You Use Your Plant Newspaper?" The thought is that the charts from recording instruments convey the real news of how manufacturing processes are being carried on.

**Uehling Instrument Company** announces the appointment of W. B. McBurney, as representative for Georgia and eastern Tennessee, with headquarters at Atlanta.

**Union Carbide and Carbon Corporation.**—The Union Carbide and Carbon Corporation in its detailed report of earnings for 1925 shows a net income, after depreciation, interest, taxes, dividends, etc., of $6,722,672. This compares with $3,472,647 in 1924. Dividends of $13,298,655 were paid during 1925.

At the Sault Ste. Marie Works 450 men recently completed a period of 365 days without a lost-time accident.

**United States Cast Iron Pipe and Foundry Company** has recently purchased 35 acres with 2000 feet frontage on the Tennessee River at Chattanooga. A new plant is planned to be completed within two years.

**Western Electric Company.**—In its report for 1925 the Western Electric Company shows net earnings after taxes, expenses, depreciation, interests, etc., of $14,283,302, equal after dividends paid on preferred stock to $17.39 per share on the 750,000 shares of no-par common. This compares with $12,126,930 or $13.87 per share in 1924.

The gross sales of the company were $299,903,974, against $298,281,138. The

*(Continued on page 397)*

total income after deduction of costs and addition of other income was $47,088,160, against $41,345,219, and the surplus after preferred and common dividends $7,424,322, against $5,399,358. A special dividend received from the International Western Electric Company from undistributed earnings on Sept. 30 totaled $9,700,000. The profit from the sale of the latter company less taxes and reserve for pension fund was $6,255,096.

Addition of these items and deduction of $2,387,136 for premium paid on the redemption of preferred stock left a balance from special earnings carried to surplus of $13,487,136. This brought the total surplus for the year to $20,911,458.

Dividends totaling $1,233,980 were paid on the company's 7 per cent preferred stock to Sept. 15. On Aug. 14 the entire $24,679,600 of preferred was called at $110 a share plus accrued dividends to the amount stated. Payments on common stock totaled $5,625,980.

**Westinghouse Electric and Manufacturing Company.**—A new four-story, brick and concrete building, having floor space of 142,600 square feet has recently been added to the Mansfield plant. It will be devoted to the manufacturing of electric ranges and electric irons. The total floor space of this plant is now 330,530 square feet or 7½ acres devoted to the manufacture of electric ware, hotel appliances, ranges and safety switches.

**Willard Storage Battery Company.**—in 1918 the premium rate of this Company to the Industrial Commission of Ohio was 99 cents per $100 of payroll. In 1925 it had been reduced to 30 cents per $100 of payroll, or by nearly 70 per cent.

**Willys-Overland Company.**—A net income of $11,422,777 is shown for 1925 by the Willys-Overland Company's annual statement. This was after interest depreciation, Federal taxes and charges for development of new models and was equivalent after allowance for 7 per cent annual dividend requirements on preferred stock to $4.36 a share earned on 2,264,661 shares of $5 par common stock outstanding. In 1924 the income was $2,086,645, or 23 cents a share on the common stock.

The total assets of Willys-Overland, as shown by the consolidated balance-sheet, were $75,076,207, as against $66,018,335 for 1924. Among the current assets were cash, $725,963; inventories, $27,300,995; notes and accounts receivable, $6,977,892, and miscellaneous accounts and notes receivable, $700,204. The total liabilities were $49,256,625, as compared with $50,045,546 for the preceding year. Accounts payable last year were $2,626,910; taxes, accrued interest, etc., totaled $2,308,040, preferred stock was $22,049,500 and common stock was $11,323,305 after depreciation. The surplus was $25,819,582, as compared with $15,972,789 in 1924.


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The book deals with practical questions—what volume of business is to be produced; what it should cost to produce it, and for what proportion of the sales total individual salesmen and branch managers may fairly be held responsible. It explains methods of compensating salesmen and sales executives according to their profitableness to the company.

The plan presented expresses sales results by salesmen, branches, territories, and customers, in comparable terms. All expenses are classified according to responsibility. You get definite suggestions for establishing and enforcing flexible budgets and standard costs in terms of fixed variable costs for each unit. These you can readily adjust to changing conditions of volume of business, prices, cost of material, and labor.

The volume outlines entire a cost accounting system for the sales department, including practical ways of distributing overhead, and suggests useful forms for daily and monthly reports of sales income and expense. *250 pages, cloth, $4.50.*

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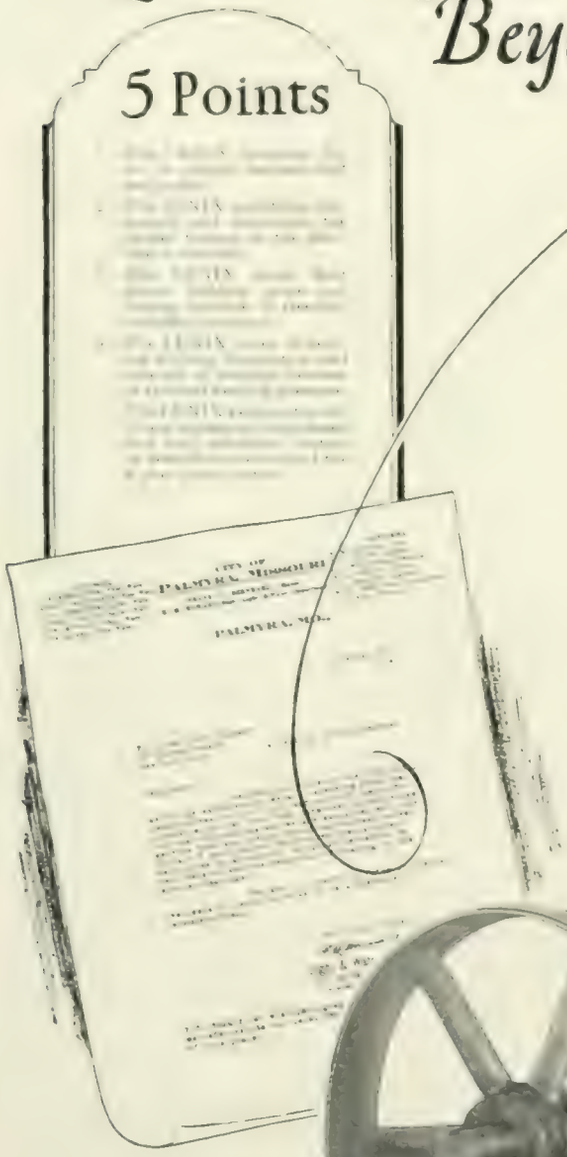


That's the expression used by the superintendent of the Palmyra, Missouri Light and Water Department, in referring to the Lenix Drives used by him on 12½ and 6 k.w. exciters, with oil engine-generator units.

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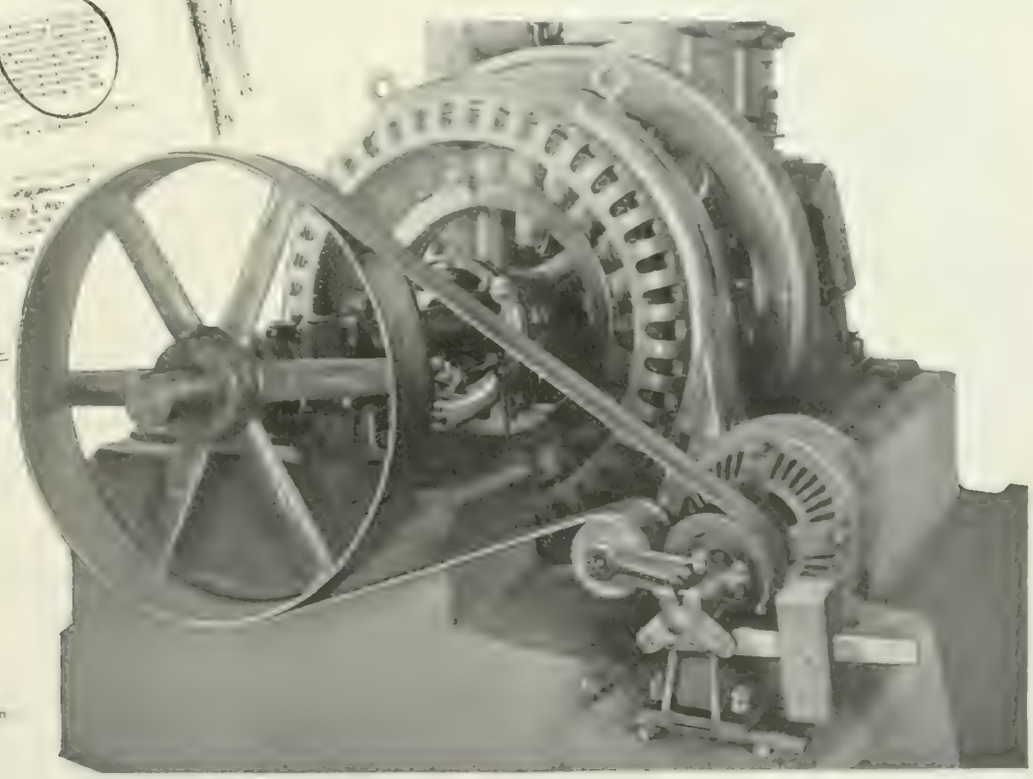

Oil engine driven 6 k.w. exciter
Driving pulley 40" dia., 6" face, 300 r.p.m.
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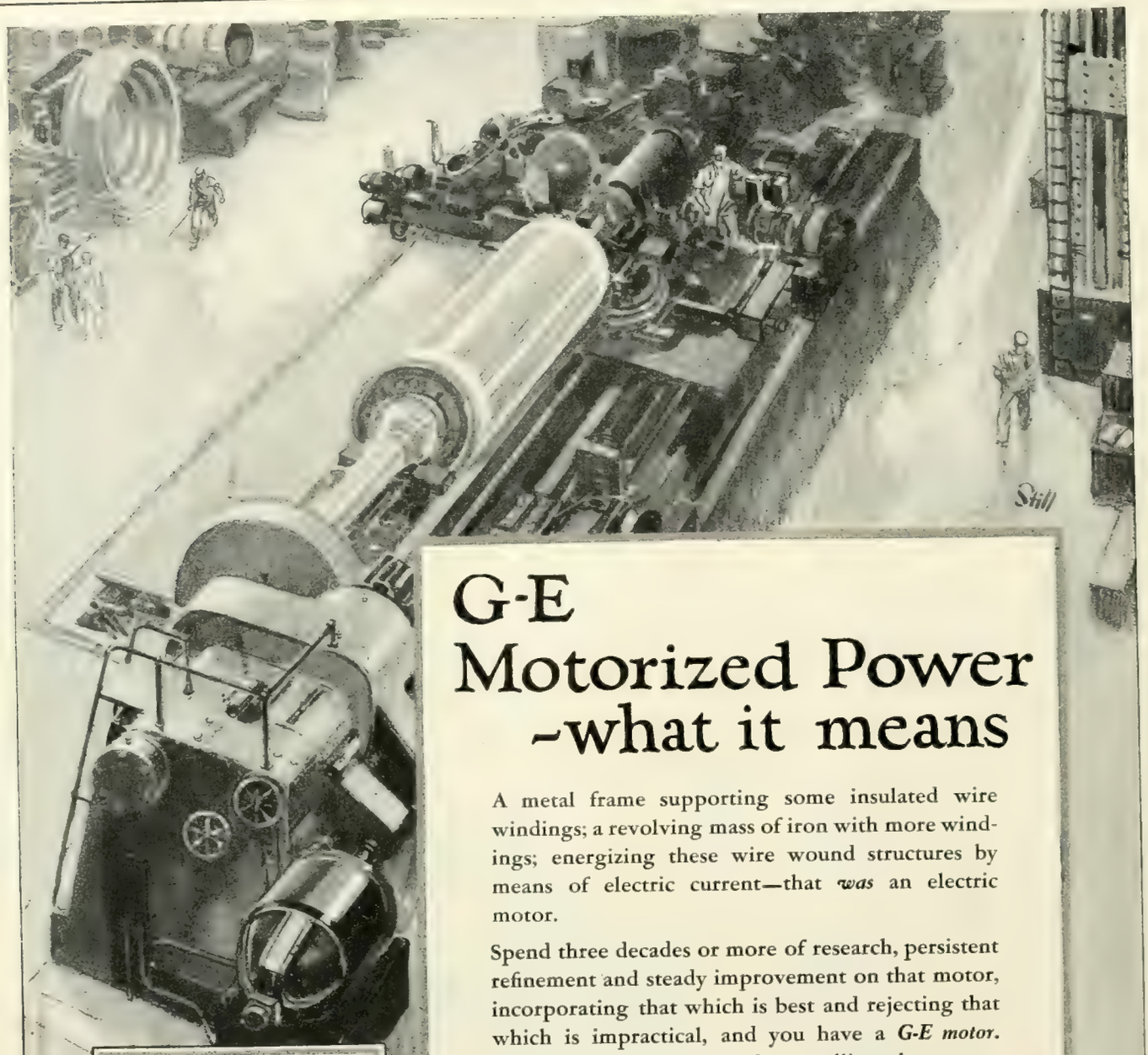

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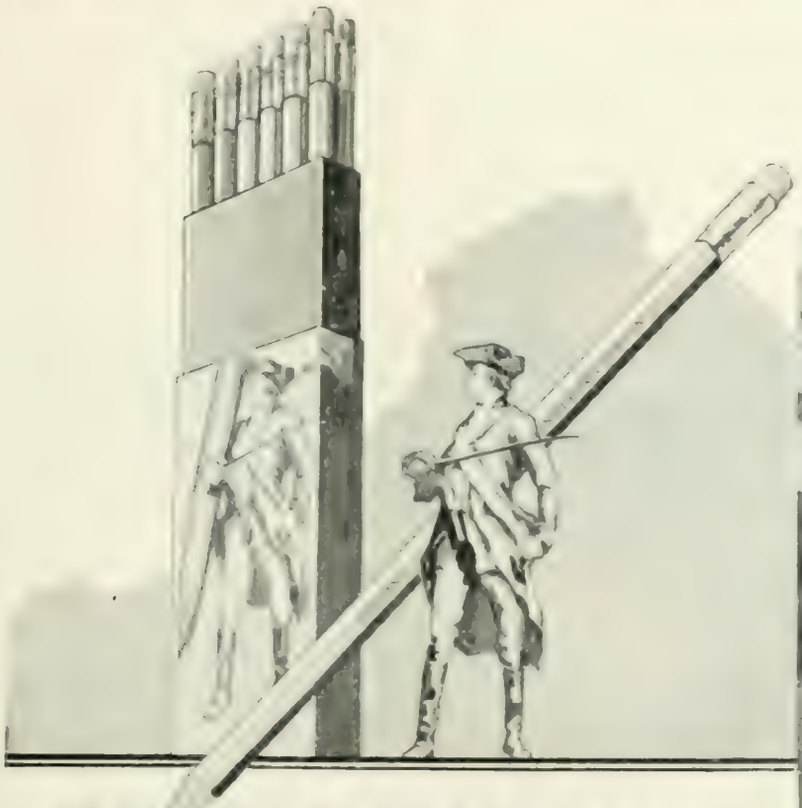

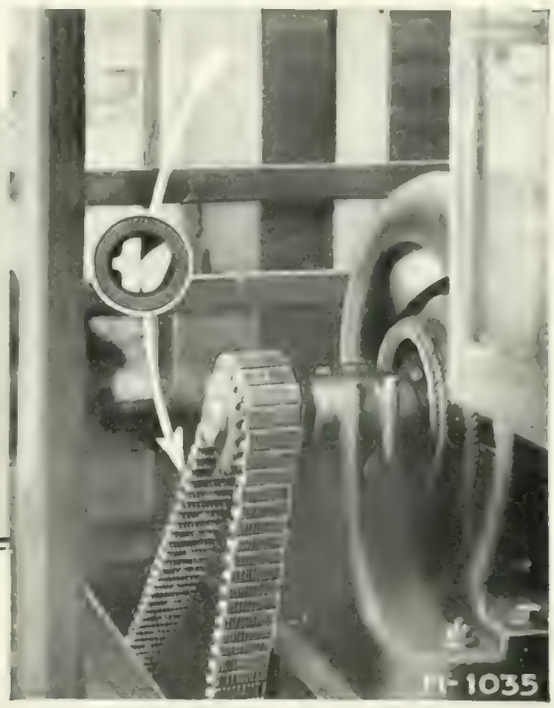


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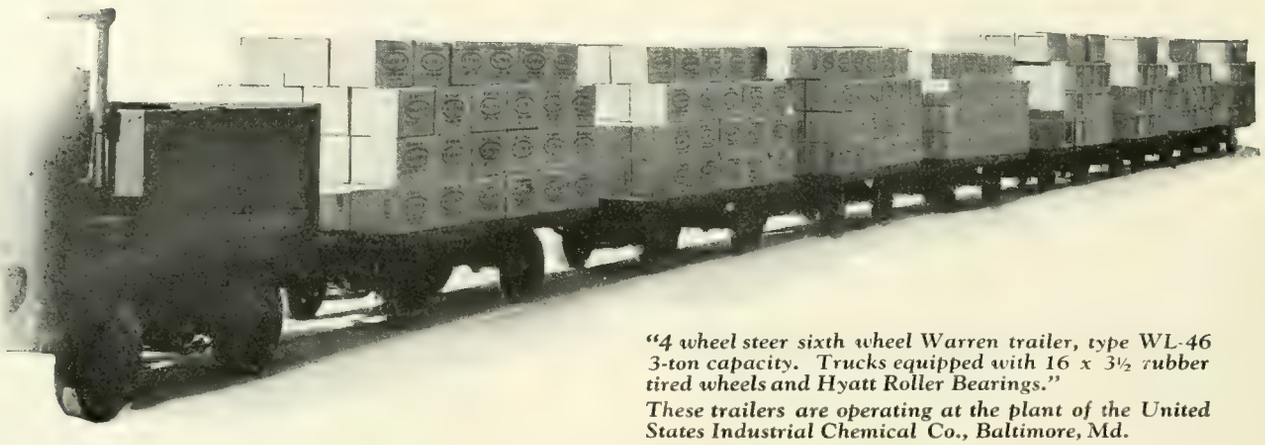
# Hyatt-equipped trucks conserve power



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*These trailers are operating at the plant of the United States Industrial Chemical Co., Baltimore, Md.*

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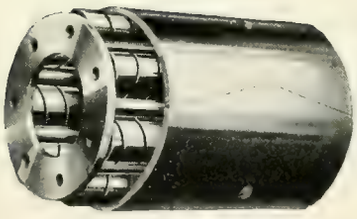

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# MANUFACTURING INDUSTRIES

L. P. Alford, *Editor* George E. Hagemann, *Associate Editor*

Vol. XI CONTENTS FOR JUNE, 1926 No. 6

Cadillac Keeps Strict Watch on Quality . . . . . Lawrence P. Fisher 409
*President, Cadillac Motor Car Company*

Maker and User Profit by New Methods . . . . . E. M. Ohm 413
*Works Manager, Westinghouse Electric Products Company*

Timely Guide to Manufacturing Control . . . . . Joseph H. Barber 417
*Assistant to President, Walworth Company*

A Market Survey and Its Results . . . . . H. L. Keely 421
*Special Representative, Johns-Manville, Inc.*

Budget Plan of Liquid Carbonic Company . . . . . Willard J. Graham 425
*Professor of Administration, Monmouth College*

Hoisting Apparatus for Buildings . . . . . *Pacific Telephone and Telegraph Company* 430

Testing Products from the User's Angle . . . . . George E. Hagemann 431
*Associate Editor, Manufacturing Industries*

Keeping Up Improved Operating Results . . . . . Joseph A. Piacitelli 435
*Engineer, Barber Asphalt Company*

Effect of Knots on Strength of Bracing . . . . . R. P. A. Johnson 440
*Engineer, U. S. Forest Products Laboratory*

Operating and Turnover Ratios . . . . . Arthur Andersen 441
*Arthur Andersen and Company*

Knitting Plant Material Control . . . . . Herbert M. Gates 445
*Superintendent, Underwear Department, Utica Cooperative Company*

Real Relation of Wages and Living Cost . . . . . L. M. Stowell 448
*Employment Manager, Detroit and Cleveland Navigation Company*

$52,000 Saved in Non-Productive Work . . . . . V. V. Heimstreet 449
*Director of Methods, General Electric Company*

Guide to Latest Information . . . . . 451

News of Manufacturing Industries . . . . . 456

Index to Vol. XI—January to June, 1926 . . . . . 457

Rutledge Bermingham, *Advertising Manager* L. G. Henderson, *Circulation Manager*

Published monthly by THE RONALD PRESS COMPANY, Place, [illegible], Publication and Executive Offices, [illegible], Publication Office, [illegible], New York, N. Y. Entered as second-class matter [illegible], at the Post Office at New York, N. Y., under the Act of [illegible]. Subscription [illegible] each.

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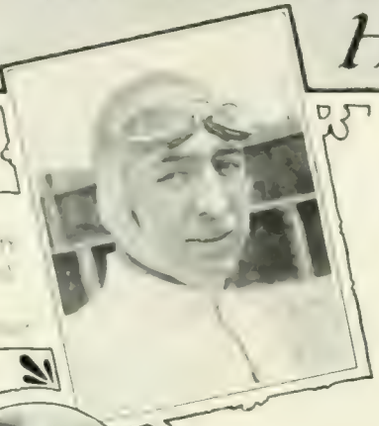
*In the Past Five Years Every New World's Record Making Race Has Been Won on*

# New Departure Ball Bearings



1922
by [illegible]
(500 Miles)
94.48
Miles Per Hour

1924
by FENGLER
(250 Miles)
116.
Miles Per Hour

1924
by BOYER
(500 Miles)
98.24
Miles Per Hour

1924
by HILL
(250 Miles)
126.9
Miles Per Hour
1925
(250 Miles)
[illegible]
Miles Per Hour

1925
by [illegible]
(500 Miles)
[illegible]
Miles Per Hour
1926
(500 Miles)
[illegible]
Miles Per Hour

1926
by [illegible]
(500 Miles)
[illegible]
Miles Per Hour

EACH succeeding record means greater speeds, more terrific strains and calls for still greater endurance—many times that ever demanded in ordinary service.

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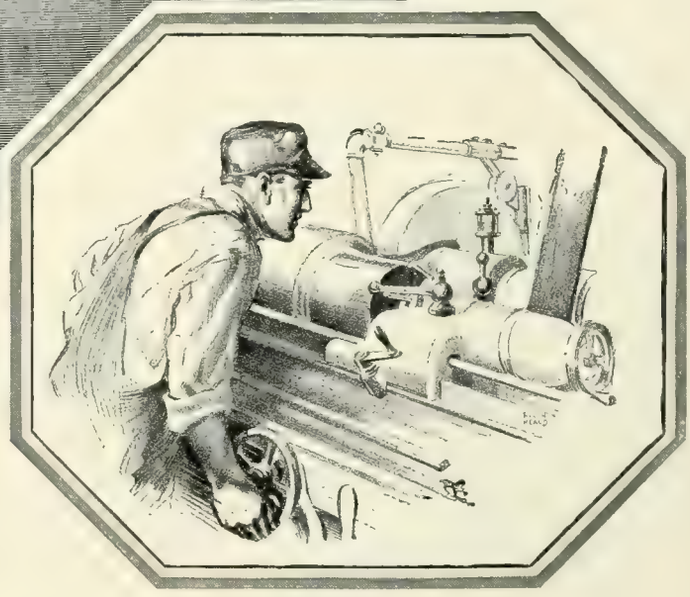

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A SURPRISING number of manufactories are dependent to a great extent upon the steel industry. The steel industry in a large measure is dependent upon grinding, upon the modern grinding machines and grinding wheels. Immense rolls up to 28 ft. long are ground to a high degree of accuracy on Norton Roll Grinding Machines. Hundreds of tons of Norton abrasives in the form of grinding wheels are employed in the finishing of billets and castings. Grinding has made practicable the working of manganese and many other steel alloys opening up a wider field for hard, tough metals.

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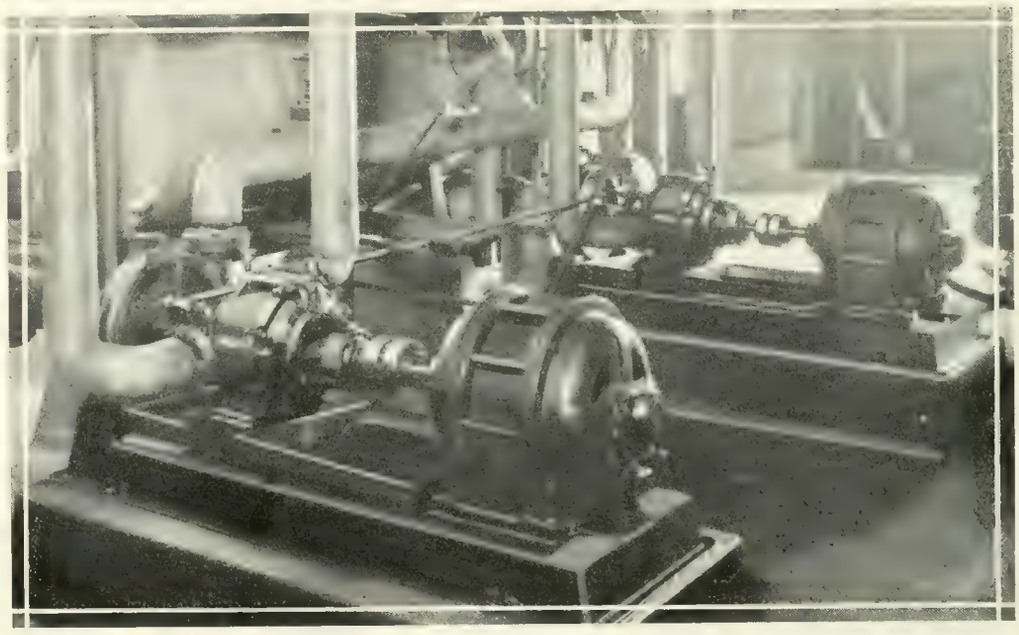

*View showing two of the six motor-driven Jennings Pumps installed at the U. S. Army Supply Base, 58th St. & 1st Ave., Brooklyn, N. Y.*

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# MANUFACTURING INDUSTRIES

VOLUME XI JUNE, 1926 NUMBER 6

# Cadillac Keeps Strict Watch on Quality

## Methods and Equipment Used to Maintain High Standards

By LAWRENCE P. FISHER

*President, Cadillac Motor Car Company*

QUALITY maintenance of product is necessarily an aim for all manufacturers who wish to attain success in their particular fields. Especially, it exerts a strong influence on prospective buyers who have related to them the favorable experiences of previous customers. Whenever the quality factor is given correct attention in manufacturing, satisfied users are boosters.

Maintenance of quality presents a problem even in a smaller enterprise. In a factory making, on a large scale, such a product as an automobile, with its multitude of parts, the problem becomes tremendous. Its significance can be best appreciated when it is realized that, of 7000 workmen employed in the Cadillac factory, one out of every 16 is active in inspection tasks that will assure excellence of construction in the product.

The work of maintaining a high degree of quality in a product varies in different industries. In automobile construction the principal efforts are devoted to assuring high quality of materials, superior workmanship as revealed in accuracy of dimensions of each part, proper balancing and alignment, noise elimination, and efficient performance of the completed product.

The importance of proper quality of materials can be visualized in the effects on the occupants of a car that is proceeding at a rate of 30 miles an hr. on a highway if the axle suddenly breaks. Such an accident will emphasize the need for care in selection of proper quality in material.

Similarly one can appreciate this need as regards the construction of a braking system on which so much depends in emergencies. Through the entire making of a car there is the constant reminder that all parts must be made of high quality material in order that the completed product may function correctly and assure safety under even the most adverse conditions.

Much in the way of favorable, or adverse, reputation of a product will depend on the kind of materials used in manufacture. Hence, raw materials, stores, castings, etc., are subjected upon arrival at the Cadillac plant to careful inspection and continuous tests to safeguard quality. Samples from all lots of raw materials received are immediately sent to the metallurgical department for both chemical and physical testing before the material is allowed to pass on for processing. Chemical and physical laboratories are specially equipped to make these analyses (see Figs. 1 and 2).

Metals frequently need to be hard all the way

through and again only have to be case-hardened, depending on the work to be performed. The metallurgical department is constantly on guard to see that copper, brass, alloys, and gray iron are made in accordance with formulas found to be most satisfactory. (See Fig. 3.)

FIG. 1 CHEMICAL LABORATORY IN METALLURGICAL DEPARTMENT

Special tests are made to maintain these standards. Specimens of metals are polished to mirror smoothness in the laboratory (see Fig. 4) for microscopic examination and photography. By means of special photographic apparatus (see Fig. 5) magnification is possible up to 1000 or 2000 times. The metallurgist is thereby able to detect from the very molecular arrangement what strength and quality each material possesses.

To determine the uniformity of the structure of material not only are these microscopic tests made but, in addition, an instrument is used that by means of a needle scratches the surface of the material and reveals by ups and downs whenever hard or soft spots are touched.

Tests to determine hardness of parts include those involving use of a scleroscope. This device is practically a diamond pointed ball, which bounces up along a scale watched carefully by an inspector. The steel ball drops from a pre-determined height upon a piece of metal to be tested for hardness. The harder the steel the higher the ball bounces. The inspector, watching the scale, knows the limits within which the ball must stay. When it falls short or bounces beyond those limits, the metal is too soft and yielding, or too hard and brittle. This test to determine hardness is used on automobile parts, such as piston rings, which have mirror-like surface and which must not be marred.

A variation of this procedure is followed under a Brinnel test which is used to test the hardness of castings and forgings before they are machined to smoothness and precision. A small ball is pressed against a piece to be tested, at a specified pressure. Then an inspector examines the size of the impression made by the ball, using an instrument which consists of a microscope with a scale of graduations similar to those on a rule.

Maximum and minimum limits are close. If the impression is too wide, it means the metal is too soft, permitting the ball to sink deeper. Such metal would twist under a very low torsional stress. If the impression is too narrow, it means the metal is too hard or brittle and breaks more readily.

To be assured of proper quality of material entering into the construction of such a vital part as the live axle shaft, there is also provided a torsion or twist test. Each shaft is put in a machine and one end kept rigid while the other is twisted under a stress of 32,000 lb. per sq. in. The twist is 2½ in. but the shaft, upon release, must never-the-less return to the original position within 0.005 in. Only shafts standing such a test are used in an automobile.

Quality of material used in manufacture of springs is given a severe test to prove ability of the actual part to stand up under maximum usage. Thus springs are subjected to continuous flexing under load for 24 hr. daily for weeks at a time (see Fig. 6.)

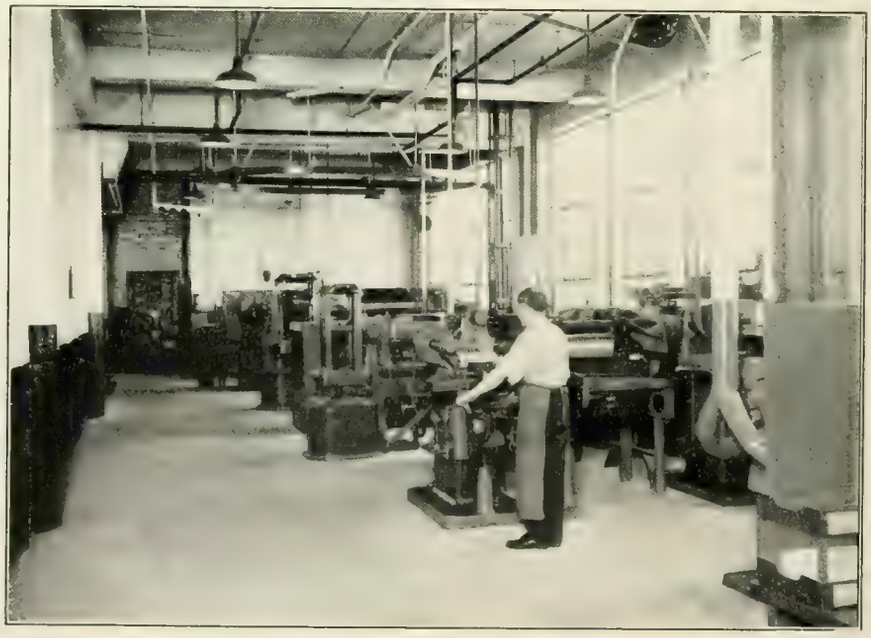

FIG. 2 PHYSICAL LABORATORY

Valve springs are run at speeds, equal to a car speed of 65 miles per hr. continuously night and day for a week to determine their quality. A car would travel over the 21,000 miles during such a test, or

nearly around the entire circumference of the world.

The gears are very important in an automobile and to test them the teeth are subjected to an impact of weight many times greater than occurs in a car while running on the highway.

Besides quality in material there must be quality of workmanship. The different parts of an automobile must be made according to measurements minutely as accurate as possible in order that the final product which is composed of such parts may be a perfect mechanism running smoothly even under severe use.

FIG. 3 HEAT TREATING OVENS, SUBJECT TO INSPECTION BY METALLURGICAL DEPARTMENT

Few realize the importance that exact measurements in construction of parts will exert on servicing of the finished product. There must be ready opportunity in the most out of way sections to remove a worn out part of the automobile and know that a replacement part will fit in exactly and perform correctly without need for machining or undue adjusting.

The ready interchangeability of parts is possible only as the tolerances in the manufacture of component parts are kept down to a minimum. The Royal Automobile Club of England realized already in 1908 the importance of such interchangeability of parts and offered what was known as the Dewar Trophy to that manufacturer whose cars consisted of parts so perfectly standardized as to allow ready replacement. This prize was won by the Cadillac car in view of readiness with which three stock cars were taken apart and the parts from each vehicle reassembled with those from the others into three cars, each of which was mechanically perfect.

To emphasize the importance of accuracy in workmanship, it is but necessary to indicate that in the manufacture of a Cadillac car there are 36,000 operations where the limit of variation permissible is 0.002 in. On 22,000 operations, the limit is held down to 0.001 in. About 800 operations are carried out with such vigilance as to allow only as much as 0.00025 to 0.0005 in. When one realizes that a fine hair measures about 0.003, a better conception is obtained of the care with which this work must be carried out in order to pass inspection.

In the inspection of a crankcase alone there are 30 tests made to assure perfection and with a transmission case the tests amount to as many as 40.

To carry out such inspection successfully some standard of accuracy had to be established. The Cadillac Motor Car Company was probably the first to introduce the use of the famous Johanssen gauges for this purpose as far back as 1906 when only three sets were owned in the United States and one of these by the government. These gauges, made originally in Sweden, are guaranteed accurate to the one-millionth part of an inch. They therefore present an ideal standard on which to base accuracy of measurements.

At present over a dozen sets of these Johanssen gauges are used to check 25,000 standard gauges and measuring instruments which cost more than $250,000 and which are used to maintain accuracy in Cadillac cars (see Fig. 7.)

Many varieties of gauges are used to conform with the needs of checking the work on different operations. Among those most extensively used are what are known as snap gauges, plug gauges and thread gauges.

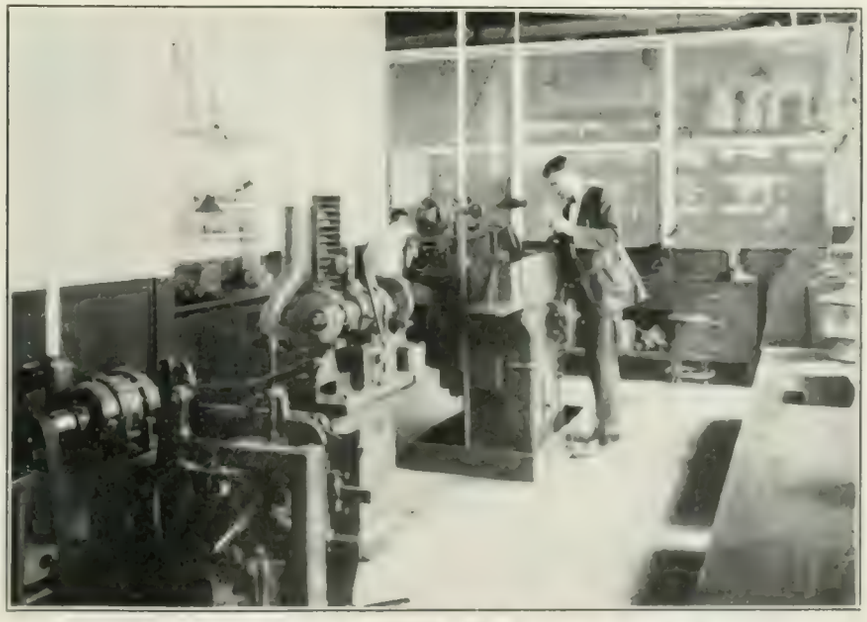

FIG. 4 [illegible]

The snap gauges are usually made of flat pieces of steel with indentures on two sides. One indenture is known as the "Go" and is sufficiently wide to allow the part to be tested to fit within the two walls. This width represents the maximum size of the particular part that is tested. The other indenture is known as the "Not Go" or minimum measurement according to which the automobile part must conform. An automobile part tested in this manner is considered satis-

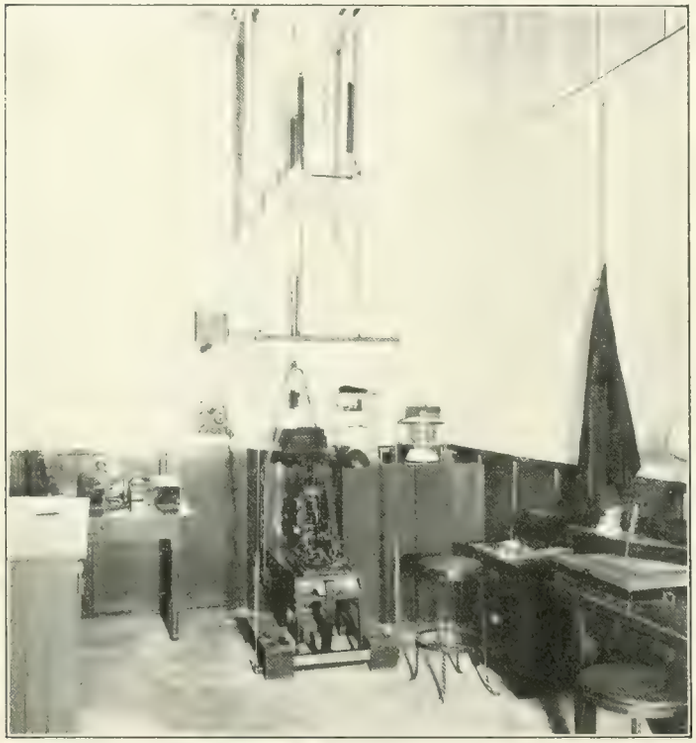

FIG. 5 PHOTOGRAPHIC APPARATUS FOR MICROSCOPIC TESTS

factory when both the "Go" and "Not Go" sections of the gauge fit snugly. The variance between the "Go" and "Not Go" is usually very slight and may be as little as the difference of 0.875 in. on the "Go" end and 0.8745 in. on the "Not Go" end.

The plug gauges, used mostly in inspecting interior diameters of parts, are round steel bars of different width at each end. The "Go" and the "Not Go" section of the plug gauges vary in diameter similar to the manner that the snap gauges differ in width.

Considerable use is also made of thread gauges, with maximum permissible size of thread on one end and minimum on the other. The screw thread comparator, a device to throw the outline of the actual thread magnified from 100 to 200 times against a screen containing the true outline drawn to this enlarged scale, is also extensively employed. This device is also used in checking up the accuracy of gauges.

The expense connected with all of the inspection and quality control operations outlined above is great. The testing instruments and the special machines required have involved a big outlay of money. Much of the equipment is the result of years of research.

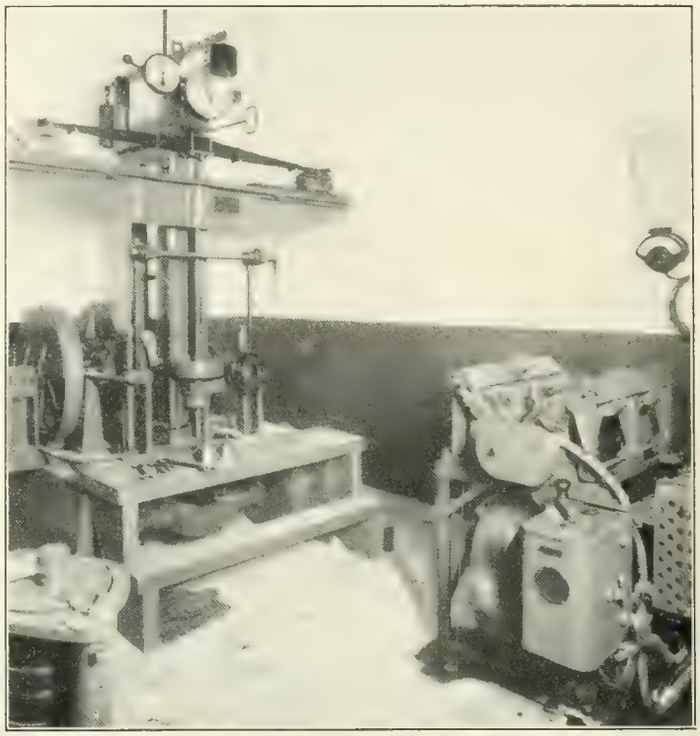

FIG. 6 CAR SPRING AND VALVE SPRING TESTING MACHINES

As superior methods of carrying on investigations are discovered a lot of the apparatus must be improved or scrapped in favor of new and better devices.

Economically the cost is well warranted. While basic changes in design are not likely to occur, yet each year advances are made in the utility, durability, safety and convenience of operation features of cars. Control of quality has been a vital factor not only in maintaining the high standards already set but also in making the new products mechanically perfect and from that standpoint commercially successful.

*(To be concluded in the July issue)*

FIG. 7 JOHANSSEN GAUGES USED TO CHECK GAUGES FOR THE INSPECTION OF AUTOMOBILE PARTS

# Maker and User Profit by New Methods

## Handling Equipment and Straight-Line Layout Cut Costs and Reduce Selling Price of Westinghouse Electric Iron

By E. M. OLIN

*Works Manager, Westinghouse Electric Products Company*

DURING 1924 and 1925 the Westinghouse Electric Products Company planned extensive revisions in the layout of its equipment and methods of manufacture for the production of electric ranges, irons, and safety switches. In 1925, a new factory unit, consisting of a four-story and a one-story brick and concrete building with a total floor space of 152,500 sq. ft., was erected and connected with the previous structures, to provide room for the new manufacturing layouts. The equipment for the manufacture of irons has just been completed and put into service, and forms the topic of the present article.

The essential materials for the manufacture of an electric iron are sheet steel, castings, mica insulation, resistance wire, wood handles, bolts and nuts, insulated cord, plugs and sockets, and, for the automatic iron, a special metal to form the thermostat, and small eyelets for the attachment of connections.

Sheet steel is received on railroad cars and is unloaded inside the new one-story building. Here it is inspected and placed in storage by electric crane. As needed, it is delivered to the cover blanking machine, also on the first floor because it requires a very heavy independent foundation which could not be constructed on the fourth floor where other manufacturing operations are conducted. The blanked covers are trucked to an elevator and carried to the fourth floor of the new building where they are delivered to punch presses, shown in the upper right hand corner of Fig. 2.

The covers, after they are formed and the holes are punched for the attachments, are delivered in boxes to a pneumatic hoist (1) which raises them to the overhead roller gravity conveyor (2). This conveyor carries them to the polishing machine conveyor (3), and at the same time acts as a storage reservoir.

The polishers transfer the boxes of covers from conveyor (2) to roller conveyor (3) and they are removed from this latter conveyor at the various machines. When the covers have been polished they are again placed in boxes on conveyor (3) at the far end of which the work is inspected. The boxes of covers are then placed on storage racks (4), which consist of gravity roller shelving. From these racks they are taken into the adjacent plating room. Here the covers are hung on racks for plating. The empty boxes are placed on an elevating conveyor (27), which delivers them to the lower belt return line of conveyor (6). The boxes go back along this conveyor to a deflector at (25), and down spiral chute (26) for refilling.

Two castings are required to form an iron—a base casting and a clamping casting. The latter holds the heating element in place on the former and also serves for the attachment of the cover.

These castings are delivered from the first floor on

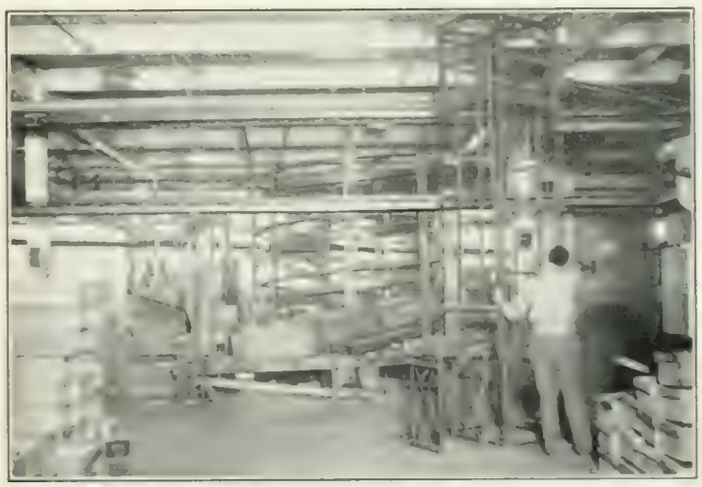

Fig. 1 Hand Hoist, Overhead and Spiral Conveyors

trucks by elevator. The boxes are unloaded on roller gravity conveyor (11) which is placed directly on the floor. The first operations are performed on the 10-wheel grinder, shown in Fig. 2. Here the upper side of the base castings and the top side of the clamping castings are ground as a moving belt carries them under the wheels. As boxes are unloaded during the feeding of the machine they are put on the roller conveyor (19) which is at floor level and delivered to the discharge end of the machine where they are filled with castings which have been ground. Boxes of ground castings are raised by means of pneumatic hoist (12) and delivered to spiral conveyor (13), which carries them to the drilling and tapping machine. The spiral conveyor provides storage space between operations and at the same time conserves room.

The drilling and tapping machine operates automatically. The castings are clamped in fixtures on a revolving cylinder which carries them through the

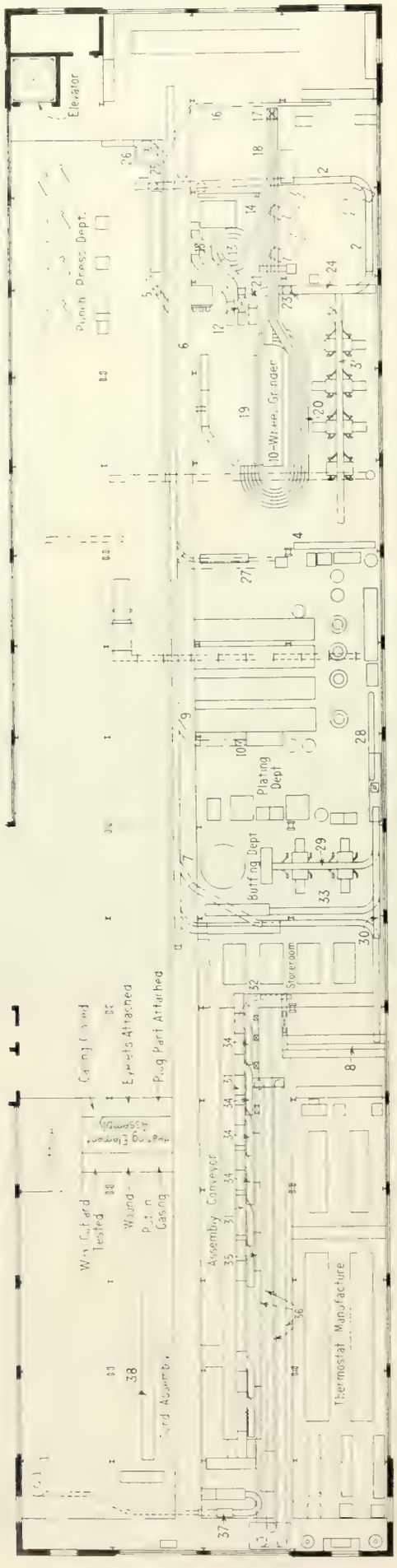


FIG. 2 LAYOUT OF MACHINES AND MECHANICAL HANDLING EQUIPMENT FOR PRODUCTION OF THE WESTINGHOUSE ELECTRIC IRON

(1) Pneumatic hoist, (2) overhead roller gravity conveyor, (3) roller conveyor at polishing machines, (4) gravity roller storage racks, (5) hand-operated hoist, (6) overhead conveyor, upper line belt conveyor running to left lower line belt conveyor running to right, (7) roller conveyor to storeroom, (8) conveyor for assembled thermostats, (9) roller conveyor to plating room, (10) lowerator, (11) floor gravity roller conveyor, (12) pneumatic hoist, (13) spiral conveyor, (14) elevating belt conveyor, (15) roller conveyor for empty boxes, (16) roller conveyor delivering boxes to grinding department, (17) pneumatic hoist, (18) overhead gravity roller conveyor, (19) floor gravity roller conveyor, (20) gravity roller conveyor supplying 10-wheel grinder, (21) gravity roller conveyor feeding hoist, (23) hand-operated hoist, (24) gravity roller storage conveyor, (25) roller conveyor feeding spiral chute, (26) spiral chute, (27) elevating conveyor for empty boxes, (28) unpacking clean conveyor, (29) roller conveyor supplying buffing machines, (30) roller conveyor for return of empty boxes, (31) belt conveyor feed line for assembly operation, (32) conveyor for empty boxes returned to storeroom, (33) roller conveyor feeding inspection benches, (34) conveyor chutes feeding assembly operations, (35) pallet conveyor for assembly, (36) overhead chain conveyor for cooling irons, (37) roller gravity conveyor leading to storeroom and shipping room, (38) cord assembly bench

cycle of operations. Completed castings are unloaded on elevating belt conveyor (14), which raises them to a height of 5 ft. 6 in. Empty boxes which have delivered the castings to the machines are placed on roller gravity conveyor (15) and delivered back to the grinding machine or sent down for a new lot of castings.

Conveyor (14) carries the base castings to a steel chute leading into a storage bunker. The drilling and tapping operations complete the work on the clamping castings and they are loaded into boxes and deliv-

FIG. 3 TEN-WHEEL GRINDER, OVERHEAD AND FLOOR CONVEYORS

ered to hand operated hoist (5). This hoist elevates them to the upper level of belt conveyor (6), running toward the left in Fig. 2. The conveyor carries them down the department to the storeroom.

Base castings are delivered from the bunker to the grinders, shown in Fig. 2, on which the beveled edges are ground. As they are completed they are packed in boxes which have been delivered from the storeroom along the lower line of conveyor (6) running to the right and deflected down onto conveyor (16). The boxes of castings are delivered to the pneumatic hoist (17) which raises them to the overhead gravity conveyor (18), carrying them to the left hand end of the 10-wheel grinder. This conveyor (18) provides storage capacity between the two operations.

The castings are again run through the 10-wheel grinder, this time to have the bottom side ground. As the boxes containing them are emptied they are put on roller conveyor (19) and sent to the opposite end of the machine to receive finished castings. Filled boxes of castings are then put on roller conveyor (20), which runs beneath conveyor (18), and are delivered again to the left-hand end of the grinding machine. Conveyor (20) has storage capacity for 10,000 base castings at one time. After completing the bottom grinding operations on this number of castings, the operator of the 10-wheel grinder removes the grinding wheels and substitutes polishing wheels for them. The 10,000 castings are then run beneath the series of polishing wheels and the bottoms are polished. Boxes are passed along conveyor (19) and are refilled with the polished castings.

Boxes of base castings are next delivered by gravity roller conveyor (21) to a hand-operated hoist (23), which raises them to any one of five tiers of gravity roller storage conveyor (24). The polishing operators remove them from this conveyor as needed and put them on gravity line (3). The final polish is put on the edges of the base casting by means of the polish-

FIG. 4 THERMOSTAT ASSEMBLY AND IRON ASSEMBLY DEPARTMENTS

ing machines and the castings are again placed in boxes and go down conveyor (3) for inspection. After inspection they are delivered to gravity storage rack (4), as in the case of the covers, and are taken into the plating room as desired.

Base castings are removed from the boxes and placed on racks for plating. Empty boxes are put on conveyor (27) and elevated to the lower return line of belt conveyor (6). A deflector at the right hand end transfers them to conveyor (16) for reuse.

Sheet steel strips for the manufacture of heel rests and handle straps are delivered to the press room on the fourth floor by elevator. These parts are punched out and formed in this department. The back handle bracket and the terminal guard are riveted together after punching and forming. Boxes of these small parts are raised in hand-operated elevator (5) to the

FIG. 5 COOLING CONVEYOR, SLATE AND CHUTE TO STOREROOM

upper level of belt conveyor (6) and passed down the department to the deflector which takes them off at (9). They are delivered over a roller conveyor to lowerator (10) down which they pass to the racking bench. The empty boxes are taken over to the unracking bench at the far corner of the room ready to receive finished parts.

The handle straps and heel rests are first washed and copper-plated. After this they are again washed and nickel-plated and washed a third time. After the final rinsing they are unracked and burnished in tumbling barrels. This operation completes the work on these parts and they are loaded into the boxes in which they came to the plating room and are carried by gravity roller conveyor (33) to the inspection bench in the buffing room. After inspection they are delivered through an opening into the adjacent storeroom.

Covers and base castings delivered to the plating room go through a similar series of plating operations, after which they are put on the unracking conveyor (28) removed from the holders and packed in boxes. The filled boxes are placed on the gravity roller conveyor (29) and delivered to the buffing machines in the next room. When the buffing operation is completed the parts are delivered to the inspection bench and thence into the storeroom. Empty boxes for these parts are carried to the plating room by gravity conveyor (30) leading from the storeroom.

The heating element is built up of several parts. Mica sheets to hold and to insulate the resistance wires are blanked in the punch press department and delivered by conveyor (6) to the winding benches. Sheet steel plates to form the casing, and the sheet steel plates holding the terminal plugs, are likewise delivered to these benches. After assembly the heating elements are sent in boxes to the storeroom.

Boxes containing the individual parts manufactured as above described, and also boxes of wood handles, screws, nuts, etc., are supplied from the storeroom to the iron assembly conveyor (31) as needed. This conveyor consists of a traveling belt from which chutes (34) lead off at the proper points to supply boxes of parts for consecutive assembly operations. The storekeeper puts a box of the required parts on the upper level of the belt, and pulls a lever which swings a deflector across the belt at the point where delivery is to be made. This reflector shunts the box down a chute (34) at that point and the box strikes a lug which automatically throws the deflector back out of position. Eight such deflectors are connected with the conveyor system. Empty boxes are sent back to the storeroom on the returning belt.

Actual assembly of the iron is done on a pallet conveyor (35). This conveyor consists of asbestos plates 12 in. wide and 5½ in. long, fitted with asbestos cloth to prevent scratching, and attached at each side to the links of a chain conveyor. The conveyor itself is 75 ft. long. At the first assembly point the covers are stenciled and have the heel rests and handle straps riveted in place. At the next station the bases are

delivered and studs are fastened into them to hold the clamping casting. Then the heating elements and the clamping casting are placed in position and bolted together. Next, the covers are bolted down to the clamping casting and the terminal insulation is added. The next operator attaches the wood handles and screws them in position. At all these points where attachments are fastened power-driven wrenches and screw drivers with self-releasing chucks are used.

The iron is now ready for testing. Each of the assembly pallets carries a connection plug, which is

FIG. 6 CORD ASSEMBLY BENCH

attached to phosphor-bronze springs on the under side making contact with bus bars supplying current for heating. The plug is connected to the iron and beneath the iron is placed a small piece of white cloth treated with a special chemical that colors brown under the action of heat. The assembly conveyor travels at the rate of 2 ft. per min. and the iron is under test along a 40 ft. length. Within this time the white cloth will assume a definite shade of brown if the iron is in perfect condition. If the color is either too light or two dark, the iron will not pass inspection and is returned for replacement of the heating element. A meter check is also made. This method of test supplants the old meter measuring plan in which there was a delay of an hour and a half.

At the end of the pallet conveyor (35) the irons are transferred to a cooling conveyor (36), a long endless chain carrying hooks at close intervals. The irons are placed on these hooks and carried up an incline and through four lengths of an overhead system enclosed in a sheet metal casing. Fans blow air through this casing to cool the irons for shipment, the cooling process requiring 1½ hr. The irons are removed from the conveyor a short distance to the left of where they were put on, and are ready for packing.

Cords for the irons are cut to length on a cord cut off bench, and are delivered to the cord conveyor assembly table (38). A chain conveyor with lugs runs down the whole length of this assembly table at about 2 ft. above the table top. Operators work at each side of the table. The first girl cuts off the insulation from the ends of the wire in a trimming machine and fits the plug over one end and a wire guard over the other end. She then throws the cord over the conveyor chain which carries it down to the next girls sitting on opposite sides of the table. One of these girls attaches the wires to the plug and the other fits eyelets by machine into the opposite end of the wires.

Another girl takes this eyelet end and places on it the two metal contacts which fit on the iron, fastening them in position. The next girl fits the split hard rubber casing to the cord and tightens it with a machine-driven screw driver. A girl on the opposite side of the table fits a screw plug to the opposite end. Finally a girl tests the cord by means of electric contacts and if it is perfect a lamp lights and a production counter registers. Cords are then coiled and delivered to the packing bench on conveyor (35).

Each iron is packed in a moisture proof bag and placed with its cord in an individual box. These boxes are run through a sealing machine and then packed three to a larger carton, sealed and delivered to roller conveyor (37). This conveyor passes through the floor and carries the boxes to spiral chutes leading either to storage on the second floor or to the shipping room on the first floor.

The automatic irons are fitted with thermostats which, when the iron is connected with the current, alternately make and break the circuit to maintain the temperature at the correct degree. The thermostat is formed from a round disk about 1½ in. diameter punched from sheets of double metal. The one metal has a different rate of expansion from the other. Holes are punched in these disks for the attachment of resistance wire and disks are heat treated and then dished by means of a press. A second heat treatment follows, with a temperature maintained constant to within one degree. Contacts are attached with mica washers separating them from the metal. The thermostats are then individually tested and after cooling are assembled with the heating element and delivered to assembly conveyor (35).

Before the new layout was put into effect the manufacture of irons was scattered throughout several departments of the plant. A great deal of handling was necessitated involving heavy expense. Smooth running of production processes was also impossible. The straight-line methods now employed with the mechanical conveyor equipment, which was designed and installed by the Mathews Conveyer Company to take care of the handling, will bring about a large economy in manufacturing. The amount of production obtainable from the installation is governed by the speed of the assembly pallet conveyor (35) which is 2 ft. per min. As there are 2 pallets per ft., 4 irons can be assembled per min. or about 50,000 per month.

It is estimated that the amount spent for conveyor equipment will be saved to the company in approximately two years. Due to improvements in manufacturing methods, the company has already been able to make a $1 reduction in the consumer's price of the automatic iron.

# Timely Guide to Manufacturing Control

## The Valve and Fittings Index

By JOSEPH H. BARBER

Assistant to President, The Walworth Company

ORDER volumes are the timeliest and most significant barometer for guiding the industrial manager in his planning toward a stabilized, profitable manufacturing control. Therefore, I urge heed to your own industry's timely barometers, and to give the findings of your statistical research more freely. This article is intended to be such a sharing of benefits in the hope that the contribution may lead toward further stabilization and greater profits in industry.

I shall describe first the Valve and Fittings Index,

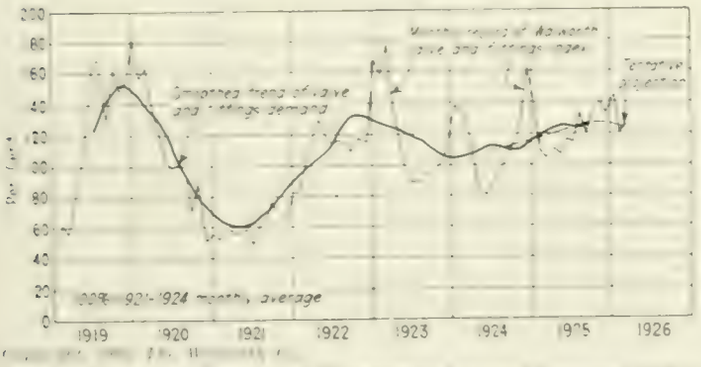


FIG. 1 MONTHLY RECORD OF WALWORTH INDEX COMPARED WITH THE SMOOTHED TREND OF VALVE AND FITTINGS DEMAND

give its general significance and to a slight degree the methods employed. This is in the hope that industrial managers will watch the quantity of incoming orders in their own industries, and then, as the exchange of trade information may make it possible, compare continuously the trend of orders with the average trend of quantity ordering volumes in all closely allied industries.

I shall use the editorial "we," for I am fully alive to the fact that much by way of development of my own thought in the matter has resulted from contact with many of my associates in the Walworth Company and from other conferences with executives, economists and statisticians who have contributed in large measure toward the final development of the index.

Before we attempted selection of the useful measure of trade, it was necessary to ask:

1. What is trade?

2. What can we find to measure the valve and fittings trade?

As to the first question, we concluded that *consumption* of goods is not really "trade." Actual consumption of goods must be in essentially steady volumes. But "steady business" is quite contrary to the experience of most of our customers who know that trade activity is not steady, but changes according to varying sentiment.

We also concluded that profits—accumulated from success in past trade—are not necessarily of themselves a true measure of current trade. Sometimes trade is active in comfortable volume even at the cost of adequate profit margins. Profits may reflect successful trade, but even before there can be profitable trade there must be *active trade*, that is, trade in good volume.

Finally, we concluded that the merchant usually thinks of his business health in terms of *new trade*. We should, therefore, expect one's impression of trade activity to be best reflected by indicators of new business being negotiated. In this sense, trade involves speculation as to the probable future consumption.

To a certain extent—an extent greatly magnified by our imagination—profitable trade seems to depend upon the ability to buy low and sell high. In actual practice, however, a merchant can but slightly govern his selling price. So, to whatever extent his fortunes are actually dependent upon careful buying, it becomes his problem to buy his greatest quantities when prices have fallen below average, thereafter disposing of his goods on the average at the more stable but relatively higher selling prices. We answer first, then, that trade changes should be reflected most promptly and most decisively by changes in the quantity of demand that may later become the basis of rising or falling production, prices and profits.

As to the second question, we knew that those who serve the consumers of valves and fittings—those front line merchants who carry the stocks against future requirements—become expert judges of future conditions affecting the consumption of their goods. When prosperity is in prospect, they order into their stock ample supplies against an assured future demand. On the

other hand, their doubts become promptly evident when they suddenly order on a hand-to-mouth basis.

Our second answer, then, simply acknowledged that changes in the *quantity of order placing* or contracting by those who trade in valves and fittings should be a useful measure of the changes in the activity of the valve and fittings trade. Fortunately, it has been possible, either directly or indirectly, to get such quantity measures so reported to us that we should be able to chart the current trend continuously.

### INDEX IS AVERAGE OF NATIONAL DEMAND

The index is but an average of 16 separate indicators of national demand for valves and fittings. Eleven indicators actually measure the volume of ordering or contracting in building, equipment and other national industries demanding or creating a demand for valves and fittings. And, given equal importance in the average, there are five indicators of the actual quantity of orders placed upon nationally representative producers for sanitary ware, brass faucets, and other of the products usually associated with the valve and fittings line.

The form of the index is essentially a direct statement of fact. To arrive at an average it is necessary, of course, to change the actual quantities of each series into index numbers. For this purpose, the 1921 to 1924 monthly average of each series is arbitrarily taken as its fixed 100 per cent base. In two series where data are available only in terms of value, the effect of price changes is eliminated. In four cases, corrections are made for incidental variations that are purely seasonal by nature and that do not represent significant changes in trade activity.

The reader may well question the practical value of any such simple index. How is it possible to interpret the signals which this index may be expected to give and how could a manager apply its current advices and warnings to the control of his business? Of course, such an index will not play the role of a mechanical prophet. It should, however, demonstrate a very real value by helping him formulate some of his vital policies. A few graphic illustrations, which speak very well for themselves, will help to indicate the sort of guidance afforded by a broad index of ordering demand such as the one we have developed for our industry.

Fig. 1 shows the monthly plottings of the valve and fittings index in the form of a relatively faint line. The purpose here is to show the great tendency toward purely speculative ordering at certain periods. The heavier line should be suggestive of the real ordering trend developed if we but wash out the effect of temporary excesses and their corresponding temporary reactions.

That heavy line is simply a year's moving average of the monthly plottings. Still, I would particularly emphasize that the year's moving average must always be plotted centrally, (or for convenience, possibly on the seventh month of the 12 months averaged.) For instance, the annual average of 1919 is reasonably to be considered as the average representative of all the high months and all the low months of that year. We would therefore expect the average plotting to appear somewhere near the middle, or approximately half way between the high and the low. Just as reasonably may we assume that, from the standpoint of time, that

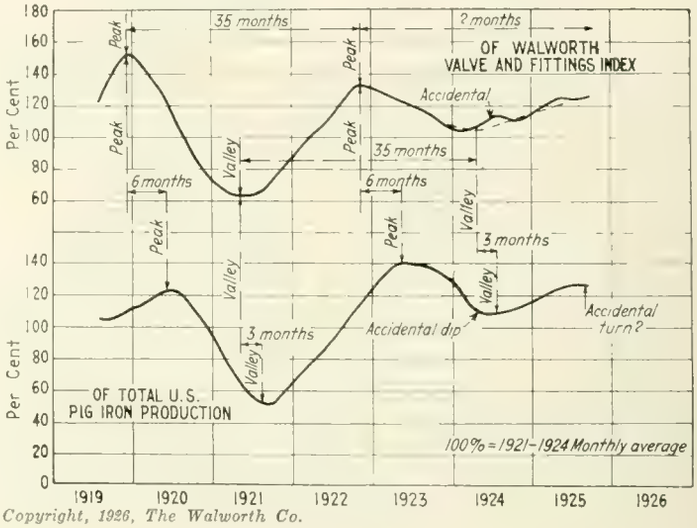


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FIG. 2 TREND COMPARISONS

same average is typical only of a point of time approximately half way between the beginning and the end of the period averaged.

Then the year's moving average progresses by dropping off the earlier January and adding on the next succeeding January. Thus, the moving average is always representative of the average conditions of a 12-month period which is distributed one-half before and one-half after the plotting location of any particular point of the moving average. For this reason, a year's moving average can never be brought down to date.

It is true that a chart showing such a year's moving average just presents "mere ancient history." Nevertheless, such a chart as in Fig. 1 does definitely force upon us a realization that these business fluctuations are much more moderate than would appear from the surface indications afforded by the index of the month-by-month fluctuations of demand rates. Moreover, it becomes evident that the violence of the upward and downward movements of this heavy trend line proves in recent cycles to have moderated considerably since the earlier trend fluctuations of 1919 and 1920.

Accordingly, however timidly we may dare to draw forward through the last half of 1925 and the first half of 1926 some projection of that heavy trend line, we cannot but arrive at at least two conclusions. First, recent monthly order levels have been illogically high. Second, the level of monthly ordering rates since the fall of 1925 is not representative of the level of monthly ordering rates likely to be persistently maintained throughout the full year of 1926.

We have often anaylzed the forecasting problem of manufacturers in the following fashion. At any par-

ticular moment of time, as he contemplates the possibility that his demand rates may or may not change, he must answer three questions:

1. When may present order levels change?
2. In what direction may they change?
3. To what extent may they change?

We shall gain an improved perspective to aid us in answering all three of these questions if we may confirm even approximately the tentatively projected trend of this year's moving average. For, the chart itself tells us that, after a brief period of a few months' excessive ordering, there is immediately a compensat-

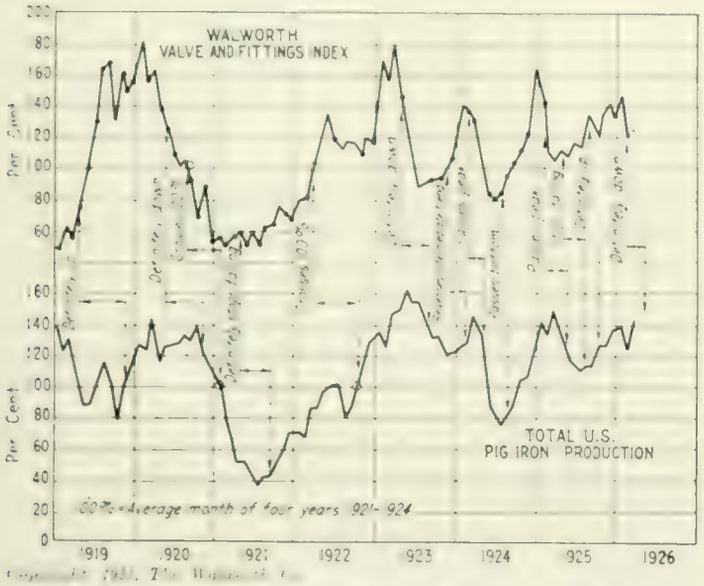



FIG. 3 ANALYSIS OF MOVEMENT OF ORIGINAL MONTHLY PLOTTINGS

ing period of under-ordering. Almost inevitably, it seems, that heavy black line does somehow average out so that there is only a moderate continuance of a persisting wave-like trend.

Now, as a further aid toward a sound confidence in the integrity of the demand index, upon the chart of Fig. 2 I have reproduced the trend line alone for two purposes. First, we may interpret its significance better by actually measuring the trend movements. And, second, while the order demand index is shown in that form, we may confirm the belief that our index is not only a very timely but also a reasonably accurate measure of broadly representative United States business cycles.

Fig. 2 definitely suggests that repetitive cycles still tend to persist and in view of the facts we must ask ourselves a pointed question. First, note that the early peak of late 1919 was followed 35 months later by a subsequent peak, and that the valley in early 1921 was followed 35 months later by a fairly well defined valley in early 1924. Then also note that these demand trend fluctuations are but a reasonably faithful advance index of the similar trend movements of that well accepted "barometer" of United States industry, namely, pig iron production. This, however, is naturally to be expected, for it was our original hypothesis that an index of order demand should anticipate by considerable margin the movement of an index of production.

The pointed question then is this: In the face of such measured and corroborated experience, are we justified in assuming that the smoothed trend of our demand index can have prolonged its persistent rise beyond approximately October or November 1925? If the answer implied is the result of good reasoning, then we must ask a still more significant question. If the peak of ordering demand has been reached, and if recent ordering levels have far exceeded what constitutes the normal average level of orders, according to any reasonable assumption, then must we not assume that that peak will be followed in turn by at least a moderate, though persistent and continuing, decline in the smoothed trend of order demand?

Of course, many have not yet come to have confidence in such statistical reasoning by analogy. Therefore, in Fig. 3 I show that much can be gained directly by analysis of the movement of the original monthly plottings of the index. In those monthly changes, which would stimulate an executive toward a vital decision, the index gives decisive warning earlier than the usually accepted record of United States pig iron production.

Now, as suggested in earlier paragraphs, the per-

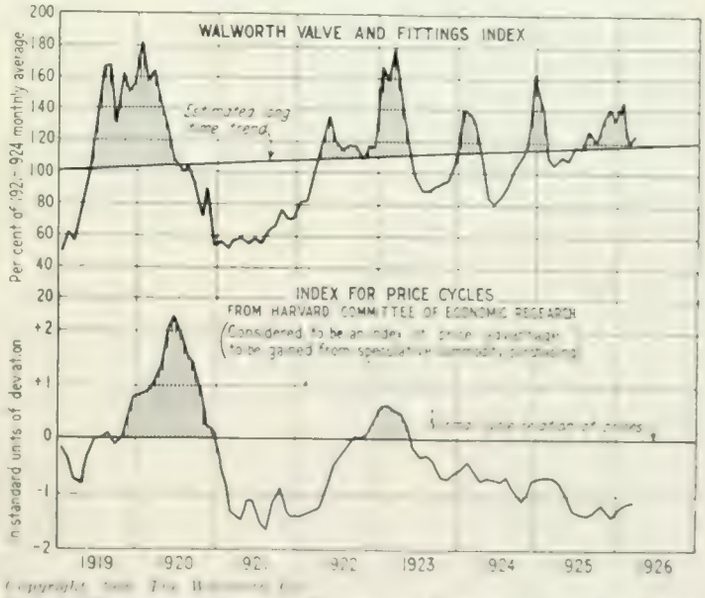



FIG. 4 COMPARISON OF THE VALVE AND FITTINGS INDEX AND THE INDEX OF PRICE CYCLES

spective gained from charts like the foregoing should permit better planning of the business and tend toward a stabilization of "volume" operations. This alone is advantageous, for steadier operations will lead to better efficiencies and increased profits for the owner, while at the same time it necessarily regularizes employment for the worker.

In addition to this, however, there is always the question of price changes, which some hold to be the

cause of volume changes throughout the business cycle. To them the business cycle appears as a vicious circle of rising prices and increasing volumes, then weakening prices and decreasing volumes. It is true, that in all stages of a business cycle prices are a significant factor. What then is the relation of cycle price changes to commodity speculation as reflected in the demand volume fluctuations shown by our index?

Undoubtedly, commodity speculation is stimulated by fear. There may be fear of delayed delivery, fear of an actual goods shortage, or fear of a price rise. Under present conditions, each of these stimuli to speculative frenzy may be negatived, for railroad service is now good and customers know that industry can now readily produce ample stocks. Though prices may not yet be stabilized, it is becoming more and more apparent that price changes now are significant primarily in the sense that they indicate what has happened in the cycle of ordering demand.

### The Speculative Advantage

In Fig. 4 the valve and fittings index is shown against the price cycle index prepared by Harvard Committee on Economic Research. That index of price cycles is significant because it measures the speculative advantage that may be gained by following a policy of commodity price speculation.

As manufacturers we are not primarily speculators. We know from experience that the real profits of industry are gained from the quantity manufacture of product. We think of commodity speculation only when we think we see an unusual combination of demand and price conditions. Fig. 4 helps to show what really happens.

In the chart, note that the largest quantities of demand (orders actually placed for production) occur before the months of greatest price advantage. In fact it is only natural that a seller would not attempt to gain for himself an above-normal price advantage until he has seen evidence of an above-normal volume of demand. When he has a back-log of orders and has developed an assurance, however ill-founded, that the large volume of order rates is going to persist, then only does he acquire courage to increase quotations.

### Price Changes Not Significant

For instance, note the lack of significance of price changes during "buying movements" of that highly speculative commodity, pig iron. The 1919-1920 buying movement in that commodity was typical of all such buying movements. During 1919, 60 per cent of the pig iron orders placed during the two years were placed before pig iron prices had advanced half way up to their 1920 peak. During the six months of sustained peak prices in 1920, 25 per cent of the time, there was placed but 15 per cent of the total orders of those two years.

Thus the highest prices did not represent real prices, in the sense that they did not represent the prices applicable to any predominant volume of goods contracted for. Probably to some extent those peak prices did indicate a large volume of fear. However, I am inclined to feel that rising prices should be interpreted to be merely a signal that the sellers have been selling in good volume. Their subsequent price increases can tend only to dampen the ardor of those belated buyers who did not "cover" when the predominance of volume occurred at the lower prices that were the real prices.

### Possibility of Price Stabilization

To the extent that the higher price quotations in any industry result from a capitalization of fear, is there a possibility of ultimate price stabilization in that industry. Facts will dispel fear. Though buying movements still persist in that "prince and pauper" pig iron industry, nevertheless in recent years there has been a marked degree of price stabilization. With facts well distributed and understood, we find now that, to even the belated buyer, a very moderate increase in quotations is signal enough to suggest that further speculative buying should be deferred indefinitely.

Having in mind the thought that high prices are not the real prices, but are essentially a signal that the sellers have been selling in good volume, let us again consider Fig. 4. This history of the index of price cycles shows us that in two major cycles the area of greatest price advantage has coincided with, or just preceded, the months of greatest decline in the order rates. Moreover, it shows us that in 1925 in spite of the growing increases in the quantity volume, there has as yet developed *no* cyclical price advantage which should prove a substantial stimulus toward speculation in commodities. In those earlier business cycles, the higher prices were not real prices. Rising prices are not an indication of rising demand, for the demand may have long since risen to its peak. Almost contrariwise, we might argue from the chart that rising prices will always force ordering rates down to lower levels.

### Only Moderate Price Rise Significant

If we come to that realization, we shall no longer fear price increases nor make extensive speculative commitments on account of them. We shall understand that any other than a very moderate price rise represents only exaggerated enthusiasm and can not be long sustained. Large quantity volumes of demand will not continue, and "volume" production rates can not be sustained under high price conditions.

Steadier prices will contribute toward more regular employment and steadier operations. Steadier operations mean better efficiencies and greater profits. To gain these ends we need to avoid booms and depressions. A depression is the headache that follows after any over-extension toward elusive goals, toward elusive price levels, profit margins and markets, that only seem at times to consume 100 per cent of possible production output. To stabilize business, we must wipe out depressions and the only way will be to eliminate the ill-founded enthusiasm that leads to a boom.

# A Market Survey and Its Results

## In Increasing Sales of a Building Material

By H. L. KEELY

*Special Representative, Johns-Manville, Inc.*

A PREVIOUS article[1] outlined the first steps in making a market survey and shows the items and factors to be studied. This paper takes up a product and shows in specific detail how the method described is actually applied.

The product is hair felt. This consists of chemically treated cattle hair, blown between layers of waterproofed and ordinary building papers. It is stitched in place with tapered and bound edges. At first it was put up in bales each containing 500 sq. ft. Later, to facilitate application a smaller package was adopted in the form of a roll containing 250 sq. ft.

This hair felt has been used extensively for a number of years for insulation in railroad cars and ice boxes; and in the building field as a sound-deadener in walls, floors and partitions, particularly in apartment house and hotel construction. The same qualities that make it an efficient sound-deadener, also make it an effective retardant to the passage of heat, and the ease of application renders it highly desirable as a "heat stop" in the walls and roofs of dwellings.

A certain amount of propaganda had been carried on for a number of years to introduce it to this market. It was not difficult to interest the person building for his own occupancy, but owing to the lack of advance information that an individual was preparing to build for himself, the contract was usually awarded before the selling force were aware of the project, in which case it was necessary to interview owner, contractor, and architect, making the selling effort three-fold. This caused an excessive selling cost with a small volume.

Further investigation demonstrated that nearly 90 per cent of all residences were erected for re-sale. In many localities large operative builders would erect as many as 200 houses in a building season. Under the conditions immediately following the war, with the housing shortage totaling several billion dollars, the builder for re-sale could not produce houses fast enough to supply the demand. Quality was forgotten and the slogan was: "Build as cheaply as possible," resulting in very shoddy construction of an impermanent nature, aptly dubbed the "Third-Mortgage House." The materials and workmanship in many cases were so poor that long before the houses were clear of first and second mortgages, it would be necessary to expend the equivalent of a third mortgage in repairs.

[1] See "The First Step in a Market Survey," May 1926, page 355

A careful review of building programs in various cities as portrayed by the F. W. Dodge Corporation, *Architectural Forum*, Copper & Brass Research Association, Bureau of the Census, and company records, indicated that the housing shortage would soon be nonexistent, and that the time was rapidly approaching when the operative builder would be compelled to incorporate "quality" into his product, as conditions were changing from a seller's to a buyer's market. The next

FIG. 1 LABEL THAT IS BEING BUILT IN THE HOUSE AFTER BEING SIGNED BY THE ARCHITECT, BUILDER AND COMPANY

step in the problem of marketing was to cultivate the builder for re-sale. This group could afford a large quantity outlet, with a minimum of selling expense after the initial order was received. The development of the plan was as follows:

Acting on the assumption that the builder for re-sale was a merchant performing the same function in the local community as the hardware merchant, grocer, druggist, and differing only in the commodity and methods of selling, it became evident that the disposal of houses—while regulated to a certain extent by the activities of real estate boards—was handled in the same manner as our forefathers used. While some of the realtors knew what it was costing them to erect and sell houses, the average contractor or carpenter had little knowledge of cost, and in far too many cases an inadequate knowledge of what was proper construction. Without exception, every town and city could be expected to produce at least three builders for re-sale who claimed to be "quality"

builders of dwelling houses in their community.

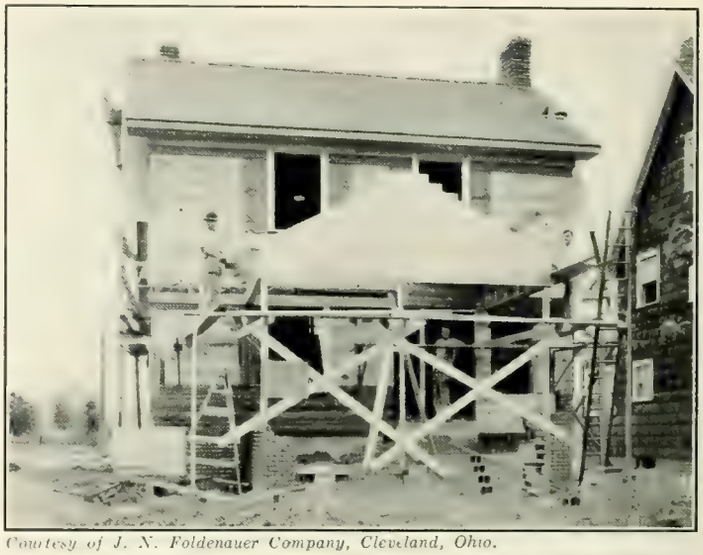
An extended trip involving a number of the larger cities over half the United States brought to light the fact that in too many cases the public was buying largely from appearance and without consideration for durability, wearing qualities, and cost of upkeep. When all the figures and data were presented it was decided that a method should be devised which would prove attractive to the builder for re-sale; something that would assist him in marketing his homes. While the presence of nationally advertised articles had in rare instances been featured by builders, it was not done on a systematic basis, and the following line of reasoning was used:

The public today buys its cigars, breakfast food, threshing machine, automobile—in fact, almost everything purchased—by means of identifying marks or packages. We have become a nation of buyers of trade-marked articles, articles of known worth, yet these same people when making a purchase of a home (which is usually the major purchase of the average man's life) buy a nondescript article on the say-so of the local assembler of materials, be he realtor, contractor or builder.

Thus the trade-marked house was evolved. The plan was this, where a builder would use the insulating material in accordance with the company's specifications, the company would inspect the house and issue a label, Fig. 1, to the builder, which was built into a panel cut out of the plaster face of the outside wall, usually in the back of a closet or as one went down the cellar stairs. When the builder incorporated this label in his house, he was required to sign the label as builder, as well as give the origin of the plans, and date of construction, forming a permanent record which was an integral part of the house. Certain sales helps were afforded the builder in the form of a sign "For Sale, a Trade-Marked House, insulated against outside weather," mentioning the company's name as a tie up with the national advertising. See Fig. 2.

The first group of these houses were built in Buffalo; the plan added approximately $250 to the selling price of the dwelling. The results obtained were satisfactory, but the builder requested additional selling help which could not be accorded on account of the close margin of profit and the sales expense. This was followed by the inauguration of what is known as the Triple-Insulated-Home. It involved three or more houses built at one time, or in close succession and, as the name implied, each house was insulated at three points: the roof, against roof communicated fires; the heating apparatus, against loss of heat from the source to the radiator; and the whole house, against all kinds of outside weather. The revenue derived from the sale of these three products in three houses was sufficiently large so that the company could afford not only to register and trade-mark the house and furnish "For Sale" signs, but could also supply selling helps in the form of a printed folder, descriptive of the particular development where the products were used.

This folder was treated in the same manner that a printer or advertising concern would do for the builder, if given the job of writing and printing the booklet. The location, transportation, social life and other facilities were described; the plans were discussed in detail and products of well-known make which were incorporated in the house, such as the hardware, heating apparatus, plumbing, fixtures, etc., were described



*Courtesy of J. N. Foldenauer Company, Cleveland, Ohio.*

FIG. 2 TYPICAL REAL ESTATE DEVELOPMENT FEATURING THE TRIPLE INSULATED IDEA

by name as well as the products made by the company. These folders were furnished without charge and a complete advertising campaign which involved the use of the company's local sales' office window, Fig. 3, the preparation of advertisements, and the furnishing of plates for use of the realtor, or builder, at his expense for the actual insertion, was also available. Several pages of advertisements appeared in mediums of national circulation. All of these advertisements bore a return coupon and the inquiries from such advertisements were referred to the local builder, together with a letter from the company's office stating that the builder either had Triple-Insulated-Homes for sale or would build them to order.

The buying habits of a group so disorganized as the builders for re-sale could not be expected to be altered over night, but representative groups were secured in Philadelphia, Buffalo, Youngstown, and elsewhere. The big feature of the plan from the sales standpoint was illustrated by a Philadelphia builder who, in his original group of 32 houses, incorporated the materials and availed himself of the assistance of the company's marketing policy. He re-ordered by telephone without competitive bid within five months on 43 more houses. This reduced the selling expense and increased the size of the sale tremendously.

Another instance of how this worked out was a builder in Cleveland, who in March 1925, placed his original order for three houses and availed himself of the sales helps. At this writing the company has re-

ceived seven re-orders, each covering from one to three houses from this builder, most of them being placed by telephone with no sales expense, the builder having standardized on these items of construction in all houses built by him. He reports a much more rapid turnover of houses, the first three being sold before completion, and the second group of three being ordered from the first samples, without competition with other builders. The results, as obtained from this market, while in percentage of product or increase in sales are not startling but connections have been established which have resulted in a steady flow of business with no sales expense, and with practically the elimination of competition for these three items.

### Outlining a Sales Policy

Where a commodity is placed upon the market for the first time, or where existing methods are not giving satisfactory results, it is often advisable to consider a

Fig. 3 Window Display Featuring Triple Insulated Homes in Merion, Pa

change in selling methods or policy. To arrive at a choice of method, let us say that all selling effort comes under one of two classes or a combination of both, namely:

Personal contact
Mechanical contact (advertising)

Personal contact as the name implies, is where the commodity is placed in the hands of the consumer through contact of individuals, either directly or indirectly. Direct contact is established where branch offices under the control of the company, or a salesman make the sale, or where the consumer comes in person to the source of supply. (Mail order business is covered later in this discussion).

Indirect sales are made where the ultimate consumer is reached through agents, exclusive or otherwise, jobbers and dealers. In some instances a fourth class, known as the manufacturer's agent, has a function between the manufacturer and the jobber, and is usually distinguished from the jobber by the size of the stock that he carries and the amount of territory involved.

In all indirect sales problems the marketing effort is two and three-fold. First, the agent, jobber and dealer must be sold; second, a demand must be created with the ultimate consumer to assist the commodity to reach its final destination, as re-orders from the agents, jobbers and dealers will depend upon the rapidity with which the goods move after coming under their control.

The double and treble selling effort is accompanied by the need for getting the message to the distributor as well as to the consumer. In some instances consumer advertising is used to create the demand and with this demand the dealer is approached and his co-operation is solicited usually with a greater chance of success than if unsupported by the evidence in the shape of orders.

To preserve the continuity of our program and to avoid repetition, let us next discuss the development of the area before taking up the mechanical contact in detail.

### Scope of Development

Most of our industries have grown from a small localized business to their present-day magnitude, although there are many noteworthy exceptions of late years, where the company was organized to manufacture and market nationally from the outset.

The sales area may be world wide or it may be confined to a single city, county or district. To determine the best method to assist in the selling by the means that follow, it is necessary that exact knowledge of the timeliness of the development be available, i.e., will the whole area be opened up simultaneously or will it be developed by districts, or units? Decision as to this point will be governed by the items that have been discussed and by the finances of the company as well as general business activities.

### Selecting the Media

We must now consider the available aids to the personal selling effort, namely, the advertising media, or, as the word has been very much abused we prefer to term it, The Mechanical Selling Effort.

There are four principal subdivisions of the mechanical method, or rather, five. The one that is purely mechanical is of such limited application as to be negligible, i.e., the use of slot, or vending machines. The four that are of interest or demand creators may be classed as:

1. Mail
2. Display
3. Publications
4. Remembrance

The groupings as shown are made with the idea of separating the media to be used for any given commodity according to the needs as brought out by the

investigation up to this point. Another way of expressing these groupings would be to say that media are used for conveying the message from industry to industry or from industry to consumer.

To consider the four in turn, we have:

1. *Mail.*—This consists of letters (first or second class) or circulars, which term is intended to embrace any printed matter as booklets, catalogs, and other mailing matter. Incidentally, it may be remarked that mail order houses sell wholly by mechanical means, the bulk of which comes under this heading, though usually supplemented by a limited representation under item three. Mail advertising generally follows up the publication and is supported by display.

2. *Display.*—Here are included two classes, mobile and immobile. The former covers moving pictures and changeable electric signs; the latter covers car cards, bill-boards and posters, both daylight and illuminated, show windows, placards, flange signs, theatre curtains, street banners, and similar devices.

3. *Publications.*—There are three general types of publications:

(a) Newspapers
(b) Magazines
(c) House organs

(a) Newspapers form a valuable medium for the selling efforts, particularly where a district or a community is to be cultivated separately or in advance of the general market, or to assist dealers to move nationally advertised commodities in their locality. Generally speaking they are best adapted for articles and commodities having an unlimited market.

Among the several classes of newspapers are the morning, afternoon, evening, and special editions of the daily; the semi-weekly and the weekly. They may be further classified as: metropolitan, urban and suburban, to say nothing of the foreign language press.

(b) Magazines may be classed generally as of three kinds:

Popular
Business
Class

Popular magazines embrace all those not appealing to a particular profession, industry or class of people; such as magazines of fiction or storied fact. The *Saturday Evening Post, Literary Digest, Life,* and theatre programs (while not magazines in the strictest sense) may be classed under this head.

Business magazines make an appeal to a particular industry or profession, as *Iron Trade Review, Iron Age, Dry Goods Economist;* or they may be devoted to the science of manufacturing as MANUFACTURING INDUSTRIES; or they may touch only a function of business, as *Advertising and Selling, Purchasing Agent,* etc.

Technical magazines form a sub-division of the business group and are those where the editorial policy deals only with the technique of a particular profession or calling, such as *Chemical and Metallurgical Engineering, Journal of the American Medical Association, American Medicine,* etc.

Business catalogs such as *Sweet's Car Builder's Dictionary and Cyclopedia, The Chemical Catalog,* and trade directories as *Thomas Register of American Manufacturers, McRae's Blue Book* and *Hendrick's Commercial Register,* etc., should also be classed under the head of business magazines.

Class magazines may be defined as those reaching a particular class of people such as *Motor Boating, Ford Owner and Dealer, Elk's Magazine, Capper's Farm Papers,* and others of similar nature.

(c) House organs may be classed as internal and external. They vary largely in size, circulation and purpose, some of the internal house organs being only intended to reach the personnel of the company while the external house organs may have a mailing list national in scope and accept paid advertising. The principal distinction between this type of publication and the regular business magazine is that the house organ is usually distributed without cost to the reader.

4. *Remembrance.*—Mechanical selling by the remembrance method consists of keeping before the desired consumer some article to be used in his daily life which calls to mind the donor. The method of distribution gives us our classifications, which are:

(a) Periodic, which is best illustrated by calendars.

(b) Events, such as conventions commemorated by souvenirs.

(c) Contact, where an article is presented to the consumer or prospective buyer by the salesman or other representative, although it may be well to include under this heading articles that are sent out in response to a questionnaire. Catalogs and other printed matter are, of course, excepted.

(d) Sampling may be placed under item (c), but in some lines it is of sufficient importance to warrant a separate listing.

These are tools that the advertising manager must use in conducting his campaign and let me state that the writer holds no brief for any method or group of media but believes that each commodity and problem must be treated individually as the survey indicates.

## CONCLUSION

The foregoing analysis presents the principal elements of the problem. After a careful study of the commodity and competing articles has determined the markets to be cultivated and the method of personal distribution, it will be a simple matter for a trained man to lay out a well defined plan of campaign that will be definitely tied in with the sales or key budget, and through it with the master budget or general plan of the company.

It is an unsolved mystery why a concern will spend large sums on plant valuation and distribution of overhead in order to arrive at a true selling cost, and then apportion the advertising expenditure in a haphazard fashion, often without the slightest effort to tie it up with the personal selling effort.

# Budget Plan of Liquid Carbonic Company

## Construction and Enforcement of a Comprehensive Budgetary Program

By WILLARD J. GRAHAM

*Professor of Administration, Monmouth College*

THE Liquid Carbonic Company engages in the manufacture and distribution of a complete line of equipment and supplies for the carbonated beverage industry, including carbonic acid gas, soda fountains, syrups, crushed fruits, extracts and flavors, automatic drink-dispensing devices and bottling machinery of all kinds. In addition to the main factory and general offices in Chicago, there are some 25 sales offices, gas plants, and gas-distributing stations throughout the United States and adjoining territory, providing an organization capable of rendering complete service to the industry in question. The annual sales are about $8,000,000.[1]

The extent and varied character of the operations of the company produce a major management problem in co-ordinating the activities of all the departments of the business. Included are: planning and regulating the rate of production so that it coincides approximately with the demands of the sales department; controlling effectively the amount and character of the inventory, which consists of raw materials and finished parts stored at the main factory, and finished goods stored at the main factory and branches. It is the purpose of this paper to explain how an efficient budgetary program aids in the solution of these problems of control.

### Organization of the Company

The general organization of the company follows rather closely the usual functional type. At the head is the president, reporting through the executive committee to the board of directors. Subordinate to him are four major executives of the company, each having complete control of a principal function. These are: production manager, known as vice-president in charge of production; general sales manager; secretary-treasurer; controller. Reporting to the general sales manager are the 12 branch managers. Reporting to the production manager are, among others, the purchasing agent, employment manager, traffic manager, and general works manager, who has the supervision of the seven manufacturing divisions. In direct charge of each manufacturing division is a superintendent reporting to the general works manager. The executive committee referred to above is composed of the chairman of the board of directors, president, sales manager, production manager, general works manager, and secretary-treasurer. This brief outline will serve to make clear later references to these executives in the discussion of the budget plan.

[1] See "Methods to Keep Inventories Down to a Minimum" by Willard J. Graham, May 1925.

### The General Budget Program

All the activities of the business are operated upon the basis of a budgetary program under the control of the executive committee. In general the plan is this: The Sales Manager estimates the total volume of sales desirable and possible, and determines its distribution among the various sales divisions and branches. Upon the basis of this Sales Budget the production manager and his superintendents assign production quotas to the different manufacturing divisions. The treasurer, after getting estimates from the different spending units, makes up the Expense Budget. To some extent the above estimates are made in co-operation, the executive committee consulting, comparing, revising, and taking into account the desires and opinions of various lesser executives. The whole general plan is from the top, "breaking down" the total among groups, divisions and units. Upon the basis of the above budgets the president makes up the Financing Budget for the year, and an Estimated Balance Sheet and Profit and Loss Statement. The whole budget program is controlled to a great extent by the president, though he is ably assisted by the other executives.

### The Sales Budget

Budgetary control of sales was first instituted in the company three years ago. The first year each branch manager estimated his own quota, basing it on the previous year's business and the anticipated increase. Salesmen as they were, they were all too optimistic. They spent the large expense appropriations they asked for, and in some cases even exceeded them, but practically all of them failed to reach their quota of sales. The result was a bad showing for the year, expenses being large and the actual sales much less than estimated.

During the next two years a new plan was tried with better success, and is being repeated this year. According to this plan the general sales manager, with such consultation and advice from his subordinates and executive committee as he deems necessary, makes up both the Sales Budget and the Selling Expense Budget

for the year. Some months previous to the end of the fiscal year the sales manager prepares a total sales figure for the next year. He bases this on the actual sales for the past year or years, and adds the estimated possible increase. This total is "broken down" into commodity totals, for the 10 major groups of commodities. This is done on the basis of the ratio of the sales of each major group for the past three to five years to the total sales for the same period, taking into consideration any special factors that have made the sales of any particular commodity greater proportionally in the past than can be hoped for in the future, or any other factors that make the sales of any commodity especially desirable or less desirable. An example of the first type would be a Pittsburgh case where 200,000 lbs. of gas were used to put out a fire. Such a case might never happen again. An example of the second type might be fruits and syrups, which, being less profitable than other lines, are not to be pushed this year, and the quota on this particular commodity is being lowered by about 30 per cent.

### Branch Sales Quotas

The above total commodity figures are then distributed among branches on the basis of percentages for the past three to five years. For example, if New York has sold one-fourth of the total gas in the past, and there are no special varying circumstances, one-fourth of the total estimated gas sales will be assigned to New York as this year's quota. Here again special factors would have to be taken into consideration. As examples:

1. Considering the Pittsburgh gas case mentioned above, it would be unjust to ask Pittsburgh to increase its gas sales in the same proportion as other branches. This increase must be distributed elsewhere.
2. Minneapolis sells a large number of soda fountains. That territory is thoroughly worked, being well organized. To ask them to increase their soda fountain sales in the same proportion as other branches would be asking an impossibility. This increase must go to other branches' quotas.
3. Some branches have recently undergone a reorganization of their sales force. They are now in a better shape to sell, have better men, better organized territories, etc. The quota to such a territory would be increased perhaps more than the percentage given to other branches. Many other such factors might enter in to vary the distribution of the total sales figure among the branches.

### Possible Readjustment in Branch Quotas

When the total commodity figures for the branches have been obtained by the above methods, and these figures combined into the grand total for the branch, it may be that the figure thus obtained seems unduly large. In consultation with the branch manager some changes may be made, but not usually, for the work up to this point has been painstaking enough to take care of most of the possible variable factors.

### Further "Breaking Down" of Totals

These total commodity figures by branches are now further broken down into months, the same percentage principle being used. These final figures, together with the Selling Expense Budgets, are submitted to the branches, and they are very infrequently changed, except, of course, at later periods when the actual sales for some good reason vary appreciably from the estimate. The branch manager further breaks down these sales figures into sales direct and to jobbers, and into sales of subdivisions of commodity classes; at the same time he distributes his expense budget as he sees fit. The report thus broken down and subdivided comes back to the general sales manager, goes to the executive committee, and is the basis of the computation of the Production Budget, Expense Budgets, and finally the Financial Budget, which is based on a summary of all the others.

While the Production Budget is based on the Sales Budget, and at all times the total to date must at least equal the Sales Budget total, the two do not correspond exactly, for there are peak periods of sales, and production must of necessity be more uniform. To "take up the slack" in months of light selling, and to have goods ready for the peak periods, there are two expedients used. One is the spring dated order, which is taken in the autumn and winter months with the agreement that the goods will not be shipped until April 1, or at least that the time of sale be considered to be the first of April and the credit period figured from that date. The other is the creation by the production department of a large inventory to carry over the periods when sales outrun production. This inventory is stored at the factory and branches.

### The Production Budget

As suggested above, the figures for the estimated sales for the year, by months and cumulative in terms of major items, expressed both in financial terms and in physical quanities, are given to the production department by the sales department, after having been approved by the executive committee. It will be remembered that on this executive committee there are two representatives of the production department, these being the production manager and the general works manager; so in effect, though it may sound somewhat paradoxical, the Sales Budget has been approved by the production department before it is formally turned over to them. Therefore, when the figures are finally given over into the hands of the division superintendents, it is "their's" to construct a Production Schedule that will enable them to deliver these goods in accordance with the estimated needs.

### Why Not a Schedule for Each Division?

Theoretically, the superintendent of each division might be expected to construct such a production

schedule as is suggested above, one that would eliminate the irregularity due to peak periods of selling. In practice, however, it has been found that with the exception of the soda fountain and machinery divisions, the Sales Budget and Production Schedule do practically agree. Therefore the first serves as both, not only as to total amount but also as to time of production, with some minor exceptions that will be noted later. There is no attempt, outside of the soda fountain division, to schedule production ahead except as it is more or less accurately and somewhat informally scheduled by the Sales Budget. This budget gives these divisions a mark to be ready to equal, but actual sales vary this schedule in an informal manner. As one division superintendent put it, "the total Sales Budget figure given to this division sets a figure which we may equal without fear of censure by the production manager or the general works manager, but we vary it informally in accordance with actual sales and shipments."

Various facts might be given to show that in practice production schedules for manufacturing divisions other than the soda fountain and machinery divisions are unnecessary. For example, the sales department originates the manufacturing orders for the apparatus division, ordering from them on a monthly basis and 30 days in advance, on the basis of estimated sales, the figure being modified perhaps by the actual sales of the month just past. Obviously, a production schedule in this division would mean very little.

Something the same is true of the fruits and syrups division and of the extract division, the manufacturing orders of these divisions being based largely on customers' actual orders. (A variation from this rule in the extract division is in connection with the large quantity production of certain extracts and flavors which require "aging," and which must therefore be produced in large quantities and in advance of sales requirements.)

The fruits and syrups division builds up a small inventory but it is relatively unimportant and can be

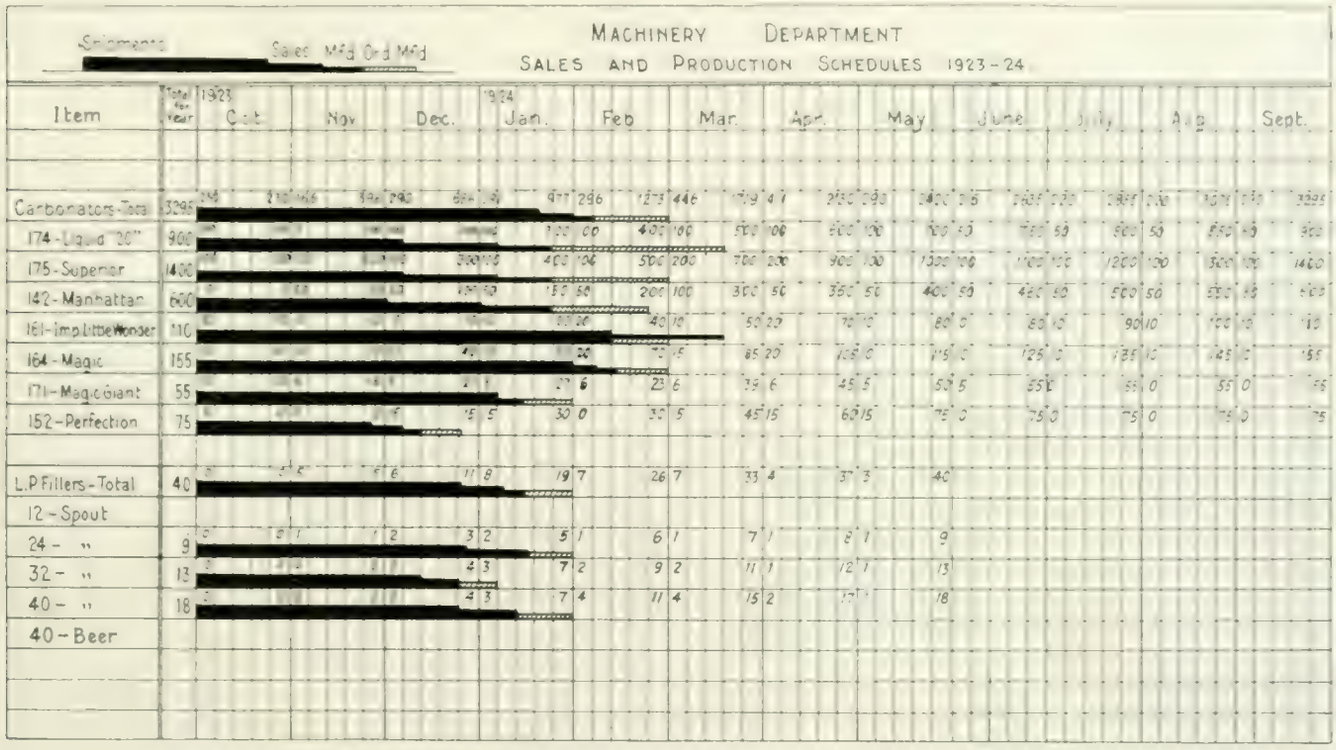



FIG. 1 MACHINERY DEPARTMENT SALES AND PRODUCTION SCHEDULES

planned from month to month in accordance with the Sales Budget as varied by reports of actual shipments. It should be mentioned here that all division superintendents, even though they do not all construct production schedules, do submit expense estimates, just as do the soda fountain and machinery divisions in connection with their rather elaborate Production Schedules.

### DIVISION PRODUCTION SCHEDULES

Conditions in the soda fountain and machinery divisions are somewhat different from those in the other manufacturing divisions. The construction of a soda fountain or of a bottling machine involves such a variety of operations, both manufacturing and assembling, and requires so long a production period, that is has been found necessary to plan activities in advance. Also, the seasonal factor is perhaps more pronounced in the case of these items than any other products of the company, and the Production Schedule must in so far as possible iron out the seasonal factor by building up an inventory in slack periods that will meet the demands of the sales department when total sales exceed the productivity capacity of the division.

Because of the above factors, when the Sales Budget

figures, in financial terms and in terms of physical quantities, are given to the soda fountain and machinery divisions, by months and cumulative, in terms of major items, this does *not* constitute the Production Schedule, as is the case in the other divisions. But, with this as a basis, the superintendent of each division and the general foreman, keeping in mind the sales estimate and at the same time the productive capacity of the division, construct a schedule that will at all times equal the estimated demands of the sales department, but will at the same time partially eliminate the seasonal factor and allow for a practically uniform output during the entire year. This Production Schedule is in terms of physical quantities and is transferred to a Gantt Progress Chart, prepared and kept up to date by an assistant to the division superintendent or by the general foreman of the division, from information coming to him in the form of regular reports from the production and sales departments.

### The Gantt Progress Chart

The Gantt Progress Chart in a variety of forms is in common use in industry today. As used in connection with the Production Schedules of the soda fountain and machinery divisions (see Fig. 1) it is similar to the one used by the head of general stores for inventory control,[2] except that the chart expressed in terms of major commodities is supplemented by charts showing the same information for the minor divisions of these major finished products. These charts portray the following information:

1. The estimated sales for each month of the fiscal year, cumulative to the end of each month. This information is taken from the Sales Budget.
2. The estimated Production Schedule for each month of the fiscal year, cumulative to the end of each month. This information is taken from the Production Schedule of the division.
3. The factory orders that have been started to date.
4. The factory orders that have been completed to date. The information for this item and the one immediately preceding is taken from the weekly production reports of the division.
5. The sales to date.
6. The shipments to date. The information for these last two items is taken from reports prepared by the tabulating section of the sales department.

When the Gantt chart has been prepared as described, an examination of it will reveal at any time these facts concerning the products of the division in question:

1. Relation of actual and estimated sales.
2. Relation of actual and estimated production.
3. Relation of actual sales and actual production.
4. Relation of sales to shipments, perhaps revealing unfilled orders.
5. Relation of production and shipments, showing the amount of finished goods on hand.
6. Relation of factory orders started and those completed, showing the amount of work-in-process.

A study of the above conditions with reference to the products of the division constitutes a rather comprehensive survey of actual sales and production conditions, and aids materially in the enforcement or adjustment of the budget program.

### Selling Expense Budgets

Expenses, so far as the budgeting of them is concerned, might be divided roughly into three groups, selling expenses, manufacturing expenses and, what we might call, general expenses. Selling expenses might be further subdivided into two groups, those which are incurred by the central office and are therefore chargeable to the whole selling organization, and those which are incurred by the individual branches. Included in the first group are all general sales office expenses, advertising expenses, expenses of conventions that concern more than one branch, salaries of sales executives, etc. These are estimated by the general sales manager on the basis of past years' expenses and sales and this present year's estimated sales, and are submitted by him to the executive committee with the complete Sales Budget.

The next step is the preparation of the Branch Selling Expense Budgets. In this group of selling expenses are included the salaries of branch managers and salesmen, salesmen's expenses, expenses of branch conventions, and the various other expenses of the branches, all chargeable to particular branches. These expenses are all estimated by the general sales manager in connection with his compilation of the total Sales Budget. When the branch manager approves his sales quota he must at the same time take some action with reference to his Expense Budget which is submitted to him at the same time. Some adjustment may be made in this expense figure at the branch manager's request, if "he kicks hard enough," but usually not. It is based largely on past percentage of expense to sales, and it is expected that if the sales quota is not attained, neither will the expense appropriation be entirely expended (though experience reveals the fact that it usually is so spent, regardless of whether or not the quota is attained.)

### Manufacturing Expense Budgets

In connection with the preparation of the Production Schedule each division superintendent prepares an estimate of the expenditures which will be necessary for the performance of the proposed schedule. These are in part for individual departments within the division and in part for the division as a whole, and are based on past expenses and past production, in comparison with the estimated production for the

[2] See "Methods to Keep Inventories Down to a Minimum," May 1925, page 471.

period, taking into consideration, of course, changes in labor costs or in the prices of material. These include both indirect and direct expenses.

The estimated labor requirements are presented to the employment manager. He translates them into financial terms, using his knowledge of the probable labor market during the coming year. Likewise, the material requirements in terms of physical quantities are presented to the purchasing agent. With his more complete information as to probable material costs he translates this estimate into financial terms. Other executives are consulted when necessary in the preparation of this budget.

These budgets, or estimates, when approved by the general works manager, production manager, and executive committee, become the appropriations for departments and divisions. Of course, in case the schedule is not attained the appropriations should not all be spent, though it might not be possible to conserve a proper proportional part.

Corresponding to the above division budgets is the chemical engineer's estimate of the gas manufacturing costs for the period, based, as are the others, on the estimated sales and production figures. This is submitted and approved in the same manner as the other division budgets. This Gas Expense Budget, being divided according to gas plants, is included in the Branch Budget, but as a separate item, as gas costs and other manufacturing and selling costs are kept separate so far as possible.

### General Expense Budgets

In general it may be said that estimates are prepared in all "spending units" by those responsible for those expenditures. Among these are:

1. The controller submits an estimate to cover all the expenses of the accounting department. This includes salaries as well as other expenses. Outside of the factory proper each department head to a great extent employs his own assistants.

2. The secretary-treasurer, since he controls the general office force, submits estimates for all office expenses, exclusive, of course, of the sales office expenses.

3. The traffic manager submits estimates covering the expenses of the traffic department, including receiving and shipping department expenses. Since this includes expense on trucks, it is rather an important item. His estimate includes figures on the trucks at the branches, but these are submitted as a part of the Branch Selling Expense Budgets.

4. The superintendent of maintenance submits an estimate of the expenses of his department, part of which estimate will be included in the budgets of the respective divisions, when it is possible to predetermine the allocation of the expense.

5. The production manager submits estimates of the general expenses and office expenses of his department, including those of the purchasing department, general stores department, and printing and stationery department.

All of the above are combined into one general budget by the president with the assistance of the controller. From this is prepared a Financial Budget. In a very general way it covers a year, being made more in detail about a month in advance, varying to accord with actual operations.

In addition to the General Budget and the Financial Budget, the president also prepares an Estimated Balance Sheet and an Estimated Profit and Loss Statement for the year. On the basis of all of the above the executive committee formally approves the whole program, although a great part of it has been tentatively approved in detail at previous meetings, the tentative approval depending upon the final result of the co-ordination of these budgets into one, and the amount of the estimated profit to be secured from such a program.

As suggested above, the control of the budget program is centralized in the hands of the executive committee. We have noted that all estimates have been approved by this committee before they become a recognized part of the budget, and that the summarizing of the various estimates and the preparation of the general budget, of the financial budget and of the estimated statements has been performed by the president who is at the same time chairman of this committee. It might be added, however, that the preparation of these estimates is hardly so much of an individual proposition as might be imagined from the general statement, as the president is consulted in connection with a great many of them. Also, the combination of these estimates, and the preparation of the Financial Budget and of the estimated statements, while nominally the work of the president and controller, involves much consultation with the other members of the executive committee, and perhaps with those who submitted the original estimates. In other words, the whole budget is not such a set procedure as might be imagined from the original statement of the case, and is very much of a co-operative proposition.

### Enforcement of the Budget

In general the budget is enforced by the same individuals who are responsible for its construction. Of the numerous reports coming to the desks of the various executives, practically all include a comparison between the actual and the estimated results of operations, and this is the basis for action by the executive who is responsible for the situation.

For example, the branch manager, if he sees that his sales are not up to the quota figure, will try to discover the cause of such a condition and remedy it, perhaps by conferences with or direct orders to his salesmen, or perhaps by cutting down branch expenses. Or, the general sales manager, if the branch sales are below the quota figure, will hold the branch

manager responsible, and try to aid him in bettering conditions. Still further toward the center of authority, if the total of sales up-to-date is below the budget figure, the general sales manager must account to the executive committee, or to the chairman of the committee the president of the company.

In much the same way the department foreman is responsible to the general foreman, who is responsible to the superintendent of the division, who in turn is responsible to the general works manager, the production manager, and finally to the executive committee. The expense appropriations are enforced by the individuals who submitted the first estimate and later accepted the budget figure in the majority of cases.

In other words, there is no special organization in the company for enforcing the budget other than through the regular channels of authority. This has been found very satisfactory, as it combines responsibility for estimating the budget figure with the responsibility and corresponding authority for the enforcement of the budget.

The president is the principal single factor in the enforcement of the budget program, but it should be noted that such control is not incident to his position as president, but was carried over from his previous position as treasurer, from which he has recently been promoted, and is due to his particularly close grasp of the financial situation. More and more of the detail of this control is being shifted to the controller, whose position in the business is an increasingly important one. He should, and probably soon will, exercise a very close control over the budget program, replacing, to some extent, the present relation of the president to this proposition.

The head of general stores, whose activities have been described in an earlier article, is seen to aid materially in presenting the facts for the control of the budget situation. By means of Gantt charts similar to the one illustrated in Fig. 1, drawn for all products and divisions, he presents to the executives, especially to the production manager, a picture of the activities of each manufacturing division, comparing their actual with their estimated performance, and at the same time showing a comparison of their actual production with the estimated sales and the actual shipments. This report is used by the production manager and to some extent by the president in pushing the production of items that are behind schedule, or in encouraging the sale of items the production of which is far ahead of the actual sales.

Results of operations under the budget system have fully justified its installation. The budget, which was considered at first as a desirable goal to be hoped for, is now regarded as a definite task to be completed. This new point of view is in itself a sufficient comment upon the advantages of this plan of operation.

# Hoisting Apparatus for Buildings

IN the new office building erected for the Pacific Telephone and Telegraph Company provision has been made for elevating heavy equipment to the upper floors. As shown in Fig. 1, a heavy girder is mounted on the roof in such a fashion that it can be extended out through the wall and hoisting tackle secured to it.

The girder rests on two rollers, one in the wall, one in the anchor strap placed about eight feet from the wall. When not in use it is pulled back so that it is invisible from the ground. An opening is provided in the wall so that hoisting operations can be directed from the roof if so desired.

FIG. 1 GIRDER USED FOR ELEVATING HEAVY EQUIPMENT

The building is six stories high but provision has been made so that six additional stories can be added when wanted. Foundations and walls have been built with this future addition in view and Fig. 2 shows how supporting columns have been extended above the roof to facilitate future construction.

FIG. 2 SUPPORTING COLUMNS EXTEND ABOVE THE ROOF TO FACILITATE FUTURE CONSTRUCTION

# Testing Products from the User's Angle

## General Motors Makes Exhaustive Studies of Motor Vehicles

By GEORGE E. HAGEMANN

[illegible] Motor Transportation Institute

WITHIN the past two years the General Motors Corporation established near Milford, Michigan, about 45 miles northwest of Detroit, the first adequate proving ground equipped for the testing of automobiles in actual service. The Technical Committee of General Motors, with the president of the corporation as chairman, and certain executives of General Motors and the chief engineers of the individual companies as members, administers the work of the proving ground, as well as that of the research laboratories at Detroit. Previous to the laying out of this property no automobile manufacturer had the facilities which were really necessary to determine the performance of motor cars. All tests which were made had to be conducted on public highways. The great inconvenience, and the impossibility of obtaining results that were even approximately accurate, are obvious.

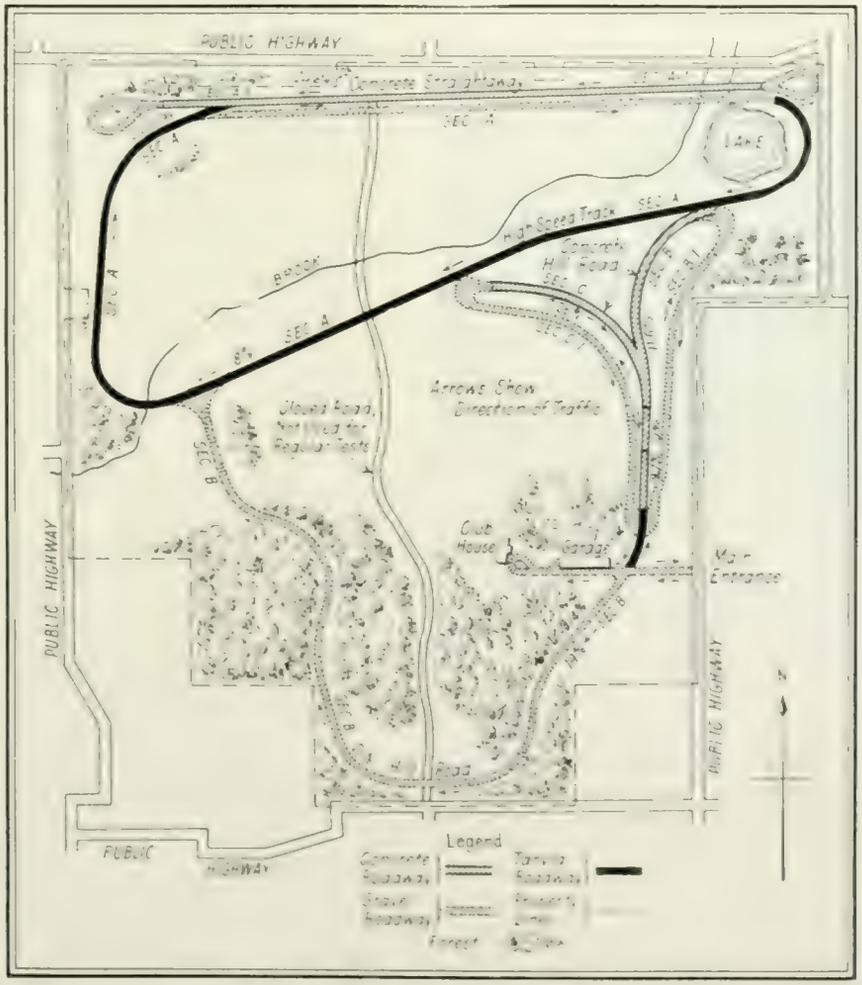



FIG. 1. LAYOUT OF PROVING GROUNDS

Traffic on the public highways and legal limits to speed made endurance and corresponding operating tests almost out of the question. Road conditions could never be definitely determined and irregularity of road maintenance precluded any comparisons of runs made at different periods. Grades were irregular and uncertain. Where special care had been exercised in highway construction the stretches of road were usually ill adapted for the investigation of factors of utmost importance in motor car and engine design. Severe tests under the grilling conditions imposed by exceedingly long and steep grades were possible at only a few places, such as Pike's Peak, Colorado, and Uniontown Hill, Pennsylvania. The inconvenience and excessive cost of conducting hill-climbing and endurance tests so far away from the main plant, the difficulty of getting measuring apparatus to the point of test and keeping it properly adjusted, and the lack of regulation over the actions of the driver and his handling of the car while away from the plant, introduced a big element of uncertainty into all the results recorded.

In order to provide facilities which would eliminate these troubles and inaccuracies incident to previous methods of road testing, the General Motors Corporation purchased 13 large adjoining plots at a point about equally distant from their factories at Detroit, Pontiac, Flint and Lansing. This tract of land comprises 1125 acres and is about a mile and a half square. The site selected is in a region where both high and low ground are available. Hence means are at hand to test cars not only under approximately level road conditions, but also on grades of various known degrees.

The proving ground is laid out to provide practically every condition which might arise in the actual

operation of automobiles. Some of the roads are of concrete; others are of gravel, macadam, tarvia, or ordinary dirt. Part of the system is level; other portions are laid out with accurately measured grades, some of which are very steep. Straightaway courses are provided; curves have been introduced at other points. At one place the cars can be run through the "bathtub,"a depression in the concrete roadway filled with water to any desired depth up to 30 in.

The general layout of the property is shown in Fig. 1. The section labeled A is located in the valley and consists of a high speed tarvia and gravel track 3.8 miles long. Section A-1 is a concrete straightaway a mile and a quarter long and 20 ft. wide with a gravel loop at each end for turning around. This section is exactly level and on it are carried out the engineering tests of acceleration, braking, fuel economy, speed, etc. The speed tests are run on days when the wind velocity is no higher than 3 miles per hr. In order

FIG. 2 VIEW FROM ONE OF THE CONCRETE GRADES

to eliminate even the slight uncertainty which this low wind velocity might introduce, all speed tests are run first in one direction and then in the other so that an average can be determined approximating the true conditions in still air.

Section B has, at the right of the illustration, a concrete test hill of 11.6 per cent grade leading onto a concrete grade of 9.7 per cent and thence over a tarvia and gravel hill road with grades as high as 24 per cent. This section connects with section A at each end.

A section labeled B-1 connects with B at each end of the concrete course in the latter.

Section C is a concrete hill road of 7.26 per cent grade running from section A into Section B.

Section C-1 is a gravel road parallel to C and connecting with B at one end.

The hill route used in many of the tests comprises most of sections A and B and totals a distance of 5.2 miles.

Very definite and rigid rules have been worked out to regulate traffic on all parts of the proving ground. Every driver must demonstrate unusual proficiency in the handling of cars and full knowledge of the special traffic rules, before he is permitted to run automobiles on the track. The directions of traffic are shown by arrows on the map. No cars are allowed to stop on any part of the course but must turn out well to the side of the road, or into definite parking spaces provided at various points. Special precautions are enforced in regard to climbing hills and particularly

FIG. 3 TEST ON A ROUGH GRAVEL ROAD

about methods of driving when reaching the brows of the hills.

Fig. 2 shows a general view of one section of the proving ground, including in the foreground a section of the concrete grade and in the distance a portion of the gravel high-speed track.

Fig. 3 shows a car in a section of gravel track purposely left in an unfinished state so that tests may be run under conditions similar to those often met on country highways.

Fig. 4 shows a portion of a dirt road of very uneven grade with a steep rise in the foreground. Fig. 5 illustrates a truck loaded with a definite weight and operating through an open field to encounter conditions often met with in the handling of trucks on highways, through industrial plant yards and in the fields in agricultural districts.

The proving ground has a large garage with facilities for 150 cars, and a machine shop and laboratory for the making of repairs and the rigging up of special instruments and devices to be used in tests. A few special testing machines are also installed, although practically all the laboratory test work on cars, engines, etc., is conducted either at the individual factories or at the research laboratories in Detroit. Very little development work of any kind is carried on at the proving ground, whose function is almost exclusively that of repeatedly testing the service quality of cars from the standpoint of the actual user, and free from problems of design and production. The facts thus brought out are transmitted to the engineering departments of the various General Motors units, or to the research laboratory, if it is a research

FIG. 4 DIRT ROAD WITH HEAVY GRADE

proposition. These branches of the organization use the data supplied either to confirm decisions or else as a basis for changing designs.

In addition to the main garage a separate garage has been provided for each of the General Motors units—Cadillac, Buick, Oakland, Oldsmobile, Chevrolet and General Motors Truck. Each of these companies is permitted to bring out cars which it manufactures and on which it desires to conduct road tests, and to run them on the track under the strict regulations enforced in the interest of safety. Any repairs or adjustments which become necessary to these cars can be made in the company's individual garage and by its own employees.

In all, over 100 distinct tests are made on every car submitted to the proving ground for thorough testing. These tests cover fuel economy, horsepower, maximum and minimum speeds, acceleration and deceleration, steering, turning radius, braking, temperature rise of cooling water, transmission of power, wear of all moving parts, action of all mechanisms, condition of car at various mileages, general comfort of riding at various speeds and on different kinds of roads, shimmying, action and wear of tires, wind resistance, vibration, visibility of road, action of car in cold weather, and every conceivable factor which may have any influence on the user.

By means of the "bathtub" the following points are investigated: How wet will the driver's feet get from water splashed up through the slots in the board for the clutch and the brake pedal? What happens to the brakes when they get wet? Does water splash up in the windshield and obscure vision? Do the driver's windows get wet? Will the ignition short-circuit? Will the carburetor take water and the engine die right in the middle of the stream? What will happen when the end of the exhaust pipe is immersed in water? Will the red hot muffler blow up?

Beauty of lines may oftentimes be an important factor in the selection of a car; hence measurements are made at the proving ground of all different body designs so that the most harmonious and attractive combination can be developed. The time required to do this and the difficulty of working from bases which would give accurate readings so that slight variations in different cars could be correctly gaged, led to the adoption of a photographic method of performing this work. A camera with an 8 in. lens of 65 in. focus is used to take the pictures of the various cars, against a cross-sectioned background. This method provides the means for determining measurements directly from the photograph instead of from the car.

One reason for the tremendous success of automobile manufacture has been the fact that the industry early recognized the need of moving forward as a whole, with competition based upon the specific qualities of individual cars rather than upon a trade rivalry of unfriendly character which brought about the extinction of competitive companies and a consequent economic and social loss. The value of this industrial policy to the consumer is evidenced by the fact that automobile prices have steadily decreased in spite of the rise in all branches of manufacturing

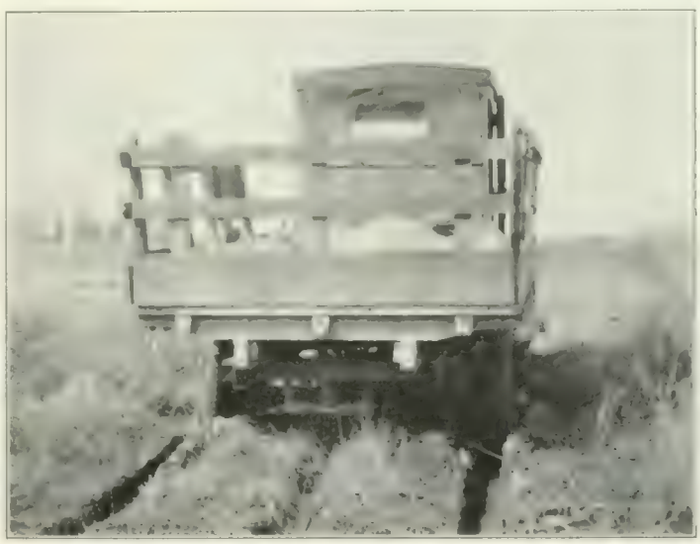


FIG. 5 TRUCK OPERATING UNDER ACTUAL SEVERE CONDITIONS

costs. Meanwhile the companies themselves have, in the main, prospered. On the broad general principle that the automobile industry as a whole must advance if individual companies are to survive and be successful the General Motors Corporation tests all makes of cars, both foreign and domestic, on the proving ground to determine the real worth of each improvement developed in the light of its value to the art.

Figs. 6 and 7 show various instruments used for specific tests of cars. Similar rigs are required for almost all the engineering data which is gathered in each case. These devices have practically all been developed either at the proving ground or in the research laboratory, and their development has been carefully studied to provide the most accurate and reliable means of measuring each factor.

Improvements are constantly being made to render the testing equipment more highly efficient. The

apparatus (Fig. 6) now used for determining acceleration gives its record by three series of perforations made by means of electric sparks in a paper tape. One series of sparks is spaced at half-second intervals. A second set is spaced at foot intervals and a third set at 10-foot intervals of travel of the car, as registered by means of a fifth wheel apparatus attached to the running board and driving a small current breaker mechanism. Experimental work is being conducted on the development of a moving picture machine and speed counter, the latter to register the travel as measured by the fifth wheel and the former, traveling at a known rate of speed, to measure the time element. In this way it will be possible to determine acceleration readings by inspection of the film instead of by the endless work now involved in counting the spark records on the tape.

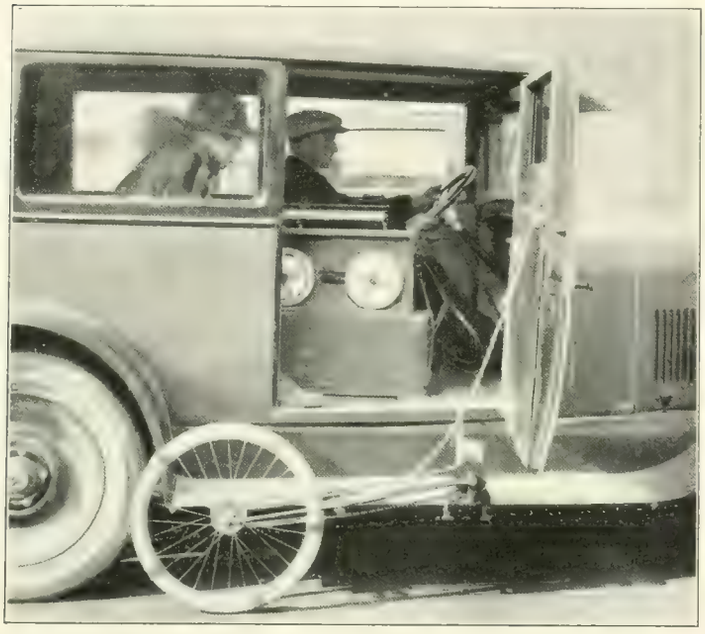


FIG. 6 ELECTRICAL APPARATUS FOR MEASURING ACCELERATION

The exhaustive data obtained from the hundred or more tests conducted on each car are carefully analyzed by engineers at the proving ground. As stated above, no attempt is made to interpret the application of this data for the various units of the General Motors Corporation. It must be put into readily usable shape, however, to be of greatest advantage to them.

In practically every case it is possible to draw up charts for the graphic presentation of the data. Comparative charts are made of like factors determined from different cars in order that the relative performance may be properly measured. It is possible by careful study of all of this data to work out the best economical combinations of qualities for each class of cars. Obviously, to make any one kind of car which would represent the present ultimate in every quality —beauty, speed, acceleration, low repair cost, high fuel economy, greatest riding comfort, and so on through the hundred or more factors involved—would necessitate the setting of a selling price which would be prohibitive on the market. But it is absolutely necessary to determine for each class of car the qualities which are in greatest demand by the largest majority of users. Engineering and manufacturing skill can then be devoted to improving these qualities in the interests of the consumer, rather than spending large sums of money to develop other qualities in which the consumer of this particular class of car has little, if any, interest.

A comfortable and well-furnished club house and dormitory has been built for the proving ground personnel. Entertainment is provided by means of radio, piano, magazines and books. Meals are prepared and served under the direction of a competent chef. Engineers from the various plants had be accommodated over night when making tests.

A repair gang is kept busy maintaining the roads in good condition. One of the advantages that the proving ground has is the ability to test all cars at all times, day and night, summer and winter, in all kinds of weather, and under conditions of road which are as nearly uniform as it is possible to keep them. The roads total a length of over 12 miles and during 1925 about 250,000 car-miles of travel per month was made, with gasoline consumption of over 20,000 gal. per month. During 1926 it is estimated that a total of over 4,000,000 car-miles will be recorded.

FIG. 7 SCALE USED TO MEASURE CLUTCH PEDAL PRESSURE

The General Motors proving ground involves a large expense. This expense was willingly shouldered in the interests of the consumer. It is at the same time well justified from a financial and economic standpoint. The company will be enabled by this means more quickly to contribute its share toward the further sound development of the automotive vehicle, producing cars that are even simpler, more dependable, of high quality, of greater utility, at a lower price and with increasingly lower operating costs—one of the most important means of modern transportation.

# Keeping Up Improved Operating Results

## At Maurer Plants of Barber Asphalt Co. Savings in Labor Cost Are Four Times Expense of Betterment Work

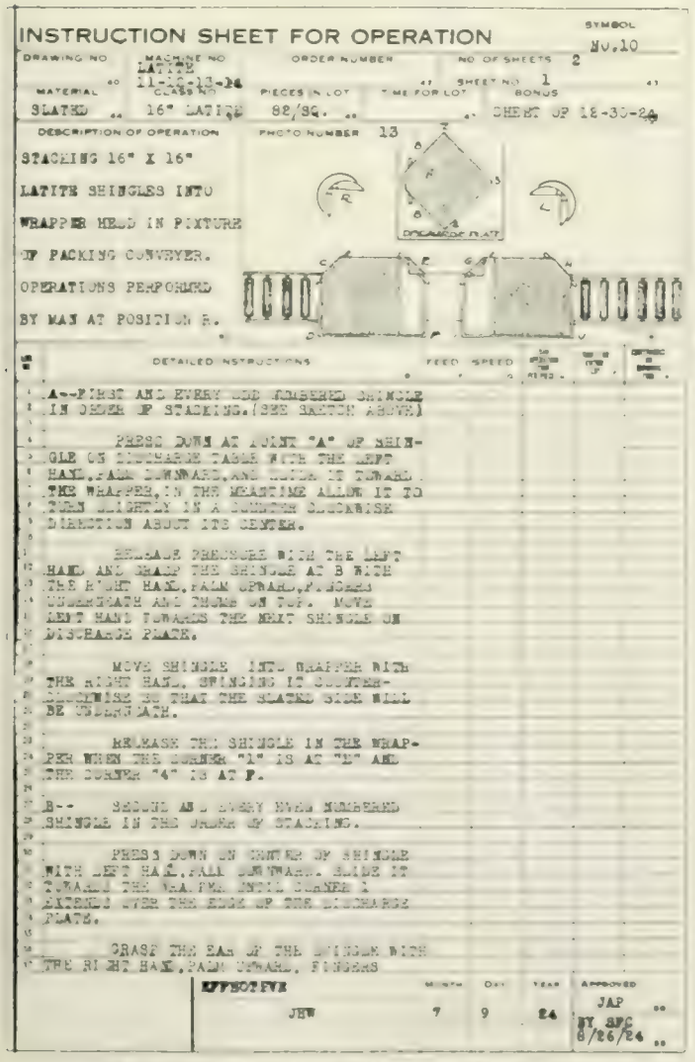
By JOSEPH A. PIACITELLI

*Engineer, Barber Asphalt Co.*

IT is easier to improve methods than to maintain them and unless the necessary tools of management are put into action it is quite probable that the newly created standards of methods, materials and tools will die their "natural deaths" so soon as they are deprived of the paternal attention which they generally receive during the period of development.

At Maurer, two measures have been taken to maintain the results accomplished.[1] First, to make adequate records of the standards for the purpose of preservation and, second, to provide means of perpetuating them. The system of written instructions which has been installed, reinforced by charts, layouts, sketches, stereophotographs and motion picture film is doing much as a preserving agent in the maintenance of standard methods and in furnishing the information necessary for effective teaching.

[1] Maintaining the Increases. April 1926, pages 281-285; May 1926, pages 347-350.



INSTRUCTION SHEET FOR OPERATION

SYMBOL No.10

DRAWING NO. — MACHINE NO. LATITE — ORDER NUMBER 11-[illegible]-13-24 — NO OF SHEETS 2

MATERIAL — CLASS NO. — PIECES IN LOT — TIME FOR LOT — SHEET NO. 1 — BONUS

SLATED .. 16" LATITE .. 82/SQ. .. .. SHEET OF 12-30-24

DESCRIPTION OF OPERATION — PHOTO NUMBER 13

STACKING 16" X 16" LATITE SHINGLES INTO WRAPPER HELD IN FIXTURE ON PACKING CONVEYER.

OPERATIONS PERFORMED BY MAN AT POSITION B.

DIAGRAM OF PLAT

DETAILED INSTRUCTIONS — FEED — SPEED — HAND — FOOT

A--FIRST AND EVERY ODD NUMBERED SHINGLE IN ORDER OF STACKING.(SEE SKETCH ABOVE)

PRESS DOWN AT POINT "A" OF SHINGLE ON DISCHARGE TABLE WITH THE LEFT HAND, PALM DOWNWARD, AND SLIDE IT TOWARD THE WRAPPER, IN THE MEANTIME ALLOW IT TO TURN SLIGHTLY IN A COUNTER CLOCKWISE DIRECTION ABOUT ITS CENTER.

RELEASE PRESSURE WITH THE LEFT HAND AND GRASP THE SHINGLE AT B WITH THE RIGHT HAND, PALM UPWARD, FINGERS UNDERNEATH AND THUMB ON TOP. MOVE LEFT HAND TOWARDS THE NEXT SHINGLE ON DISCHARGE PLATE.

MOVE SHINGLE INTO WRAPPER WITH THE RIGHT HAND, SPINGING IT SLIGHTLY SO THAT THE SLATED SIDE WILL BE UNDERNEATH.

RELEASE THE SHINGLE IN THE WRAPPER WHEN THE CORNER "1" IS AT "1" AND THE CORNER "4" IS AT P.

B-- SECOND AND EVERY EVEN NUMBERED SHINGLE IN THE ORDER OF STACKING.

PRESS DOWN ON CENTER OF SHINGLE WITH LEFT HAND, PALM DOWNWARD. SLIDE IT TOWARD THE WRAPPER UNTIL CORNER 1 EXTENDS OVER THE EDGE OF THE DISCHARGE PLATE.

GRASP THE EAR OF THE SHINGLE WITH THE RIGHT HAND, PALM UPWARD, FINGERS

APPROVED — MONTH — DAY — YEAR

JHW — 7 — 9 — 24 — JAP — BY BFC 8/26/24

Fig. 1 Instruction Sheet for Operation

The degree of detail in which these instruction sheets are written depends largely upon the importance and repetitiveness of the operation performed. For instance, in case of cleaning a certain section of a machine at the end of the day's run, the instruction sheet is written as briefly as possible and yet in sufficient detail to avoid any possible misunderstanding as to the amount and quality of the work expected. The cycle of motions necessary for the feeding operation is performed on an average of 18,000 times per day by each feeder and this is one of the many cases which places motion study on a pedestal above that of any other method of analysis. To say "feed shingle into machine" is not enough; nor will it be adequate to say "Grasp shingle with left hand and feed it into machine with the right." This method has been recorded so as to cover each element of motion in the cycle and in such a way that there is no doubt as to the sequence and approximate path of those elements involving motion.

The chief purpose of the instruction sheet is to make the transference of skill practical in that it provides the necessary data for the foreman to teach the men the correct motions involved in the process and which will enable them to attain automaticity in the shortest period of time possible. The standardization of methods and the system of instruction has in many cases reduced the learning period 50

M P 6330

**MESSENGER** MUST DELIVER THIS IN THE ORDER OF THE BASKET NUMBERS AS WRITTEN HERE

STANDING ORDER NO. 74
NO OF SHEETS 2
SHEET-NO 1

| SUGGESTED BY | APPROVED BY | EFFECTIVE BY | TYPED BY | APPROVED AS WRITTEN BY | | | | | | | | THIS COPY TO BE RETAINED BY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61 | 65 | JHW | WPL | | 97 | 53 | 43 | 37 | 94 | | | |

**WHO** IS TO DO THIS WORK
BASKET NO AND NAME 53 LAMONT
43 RAMBURG.
NAME OF POSITION OR FUNCTION LOADING FOREMAN

**WHERE** IT IS TO BE DONE
BUILDING NO R.P. ROOM NO WORK PLACE NO
NEAR WINDOW NO NEAR DOOR NO NEAR COLUMN NO

CALENDAR **WHEN** THIS WORK IS TO BE DONE

| HOUR | DAY | MONTH | YEAR | DAILY | WEEKLY | MONTHLY | YEARLY |
|---|---|---|---|---|---|---|---|
| 11 A.M | LAST MON | EA | EA | | | X | |

SEQUENCE **WHEN**

**WHAT** IS TO BE DONE AND **WHY**. STATING THE REASON WILL ALWAYS MAKE EASIER THE REMEMBERING OF THE STANDING ORDER.

THE LOADING FOREMAN WHO HAS CHARGE OF SHIPPING ON #6 TRACK, THE LAST MONDAY IN EACH MONTH, SHALL COLLECT ALL EMPTY SILICA AND TALC BAGS ON THAT DAY AND SHIP THEM BACK L.C.L. THIS DAY IS SELECTED FOR THIS WORK BECAUSE A REGULAR L.C.L. CAR GOES OUT THEN ON SCHEDULE. THE METHOD TO FOLLOW IS DETAILED ON SHEET #2 OF THIS S.O.

WHY?- TO TAKE PROMPT ADVANTAGE OF AVAILABLE EMPTY BAG REFUND, AND GET THEM OUT OF THE WAY IN AN ORDERLY MANNER TO MAKE ROOM FOR MORE USEFUL MATERIAL.

**WHO** TO INSPECT IT
BASKET NUMBER AND NAME 37 MARKULIN CHECKER

**WHEN** TO INSPECT IT — HOUR: BEFORE SEALING CAR THAT DAY. DAY: L.C.L.

**WHO** OVER-INSPECT IT
BASKET NUMBER AND NAME ASST. SHIPPING CLERK 94 O'BRIEN.

**WHEN** TO OVER-INSPECT IT — SAME DAY BY TALLY SHEETS.

**WHOM** TO NOTIFY AT THE TIME THIS WORK IS COMPLETED
BASKET NUMBER AND NAME 50 REMINDER FILE

**WHOM** TO NOTIFY IF WORK IS NOT COMPLETED WHEN AND AS CALLED FOR HEREIN.
BASKET NUMBER AND NAME 61 STRIEWIG

SEND REMINDERS AS CITED BELOW

| BASKET NUMBER AND NAME | HOUR | DAY | MONTH | YEAR |
|---|---|---|---|---|
| 53 LAMONT | | | | |
| 43 RAMBURG | 9AM | LAST MON | EA MO | EA YR. |
| 37 MARKULIN | | | | |
| 94 O'BRIEN | 9AM | LAST MON | EA | EA |

SHOW DUPLICATE COPIES OF THIS STANDING ORDER TO BASKET NUMBER AND NAME

36 MACSKIMMING
53 LAMONT
43 RAMBURG
37 MARKULIN
94 O'BRIEN
97 PIACITELLI
65 SLUTZKER
61 STRIEWIG

SIGN OR STAMP ORIGINAL STANDING ORDER WHEN YOU HAVE SEEN COPY OF IT

| SUGGESTED BY | APPROVED BY | EFFECTIVE BY | I HAVE MADE COPIES OF THIS STANDING ORDER AND SENT THEM AS LISTED ABOVE | I HAVE CHECKED THIS COPY AS WRITTEN AND APPROVE IT | I HAVE REGISTERED THE REMINDERS | I HAVE REGISTERED ALL THE DATES ON TIME TABLED |
|---|---|---|---|---|---|---|
| 61 | JB | JHW | | | | |
| DAY 30 MON 1 YEAR 25 | DAY 22 MON 1 YEAR 25 | DAY 23 MON 1 YEAR 25 | DAY MON YEAR | HOUR DAY MON | HOUR DAY MON | HOUR DAY MON |

FIG. 2 STANDING ORDER RELATIVE TO SHIPMENT OF EMPTY BAGS

per cent, to the gratification of all concerned.

Stereoscopic photography has been playing a very important part in our development work as well as in the maintenance of methods and equipment. By such means many of the processes have been effectively recorded for the purpose of study and with these photographs and process charts made from observation, we have been able to attain satisfactory results from the analyses. By taking a series of stereophotographs, the writer has been able to record methods, equipment and tools in a few hours which would otherwise necessitate long detailed description, thus saving time as well as getting a true picture of the surrounding conditions.

The Standing Order system has been installed and has proved a reliable means of getting work done periodically and effectively. It has done much as a supervising agent to perpetuate the new standards and to insure the effective use of them. Standing Orders have been suggested by men in various capacities—from clerk to vice-president—affecting every department within the three plants and cover a wide range of functions and problems such as standards, production, storage, shipping, receiving, inspecting, charting, office management, etc.

Fig. 2 shows a standing order intended to perpetuate the work of the loading crews relative to the shipment of empty bags, and leaves no doubt as to who is responsible, for *what*, *when*, and *why* the work must be done as prescribed. The *how* of the work is often written with the *what* and *why* and whenever more space is required a second sheet (Fig. 3) is used to record the necessary additional information. In case of the maintenance of standard methods of production the *how* is generally written on Instruction Sheets in the degree of detail necessary. Fig. 4 shows a standing order which is characteristic of the latter, plainly telling what is to be done and fixing the responsibility for the work. The Instruction Sheets referred to are kept by the foreman in charge of the work, who acts as the instructor of the operations under his supervision. In this way the method is preserved by the Instruction Sheet and perpetuated by the Standing Order which provides the necessary means of getting action and a check on its performance. To insure the effectiveness of the Standing Order system the Reminder System, serving as a necessary adjunct to it, reminds the men of the work they are to do and furnishes the necessary information to do it.

Another phase of the maintenance problem which is being solved is that of keeping the plant clean. In carrying out the cleaning program it is necessary for us to deter-

STANDING ORDER NO. 74
NO. OF SHEETS 2
SHEET NO. 2

(1) The Silica dust bags will be found in the Deck House bundled and tied for shipment in lots of 25.
(2) The bundles of bags are to be taken from the Deck House by members of your crew and carried into the L. C. L. freight car.
(3) The Talc bags will be found in Building No. 1, Festoon Room, between doors 110 and 112 and also in Building No. 2, Festoon Room, between doors 111 and 115. Bundled and tied in lots of 25.
The Talc bags in Building No. 1 shall be piled on a baggage truck and wheeled into the L. C. L. freight car passing through the Roofing Storage and the door where the L. C. L. car is spotted.
When neither of the shingle cutting machines in Building No. 2 on the lower floor are operating the Talc bags in Building No. 2 shall be carried to a baggage truck, placed at the top of the stairs near the shingle cutting machine No. 3 on the lower floor.
When truck is piled full, wheel the bags through the Roofing Storage and the door where the L. C. L. car is spotted, into the freight car.
Then pile the bags into the car.
When either one of the shingle cutting machines is operating, members of your crew shall carry the bags to the L. C. L. car by passing through door No. 118 so as not to interfere with shingle cutting operators.
(4) Get shipping tags from 94 O'Brien, who fills them out and shipping foreman shall tie one of them to each bundle of bags, to effectively mark its destination. Separate tags are provided for Silica and Talc bags.

FIG. 3 FORM USED TO RECORD ADDITIONAL INFORMATION

mine the degree of cleanliness to which the work must be performed; to provide tools necessary to do it in the shortest time practical and to get the work done. Like those of any operation in production the methods and tools have been standardized and standing orders written to maintain them and we are securing very good results where this work has been completed.

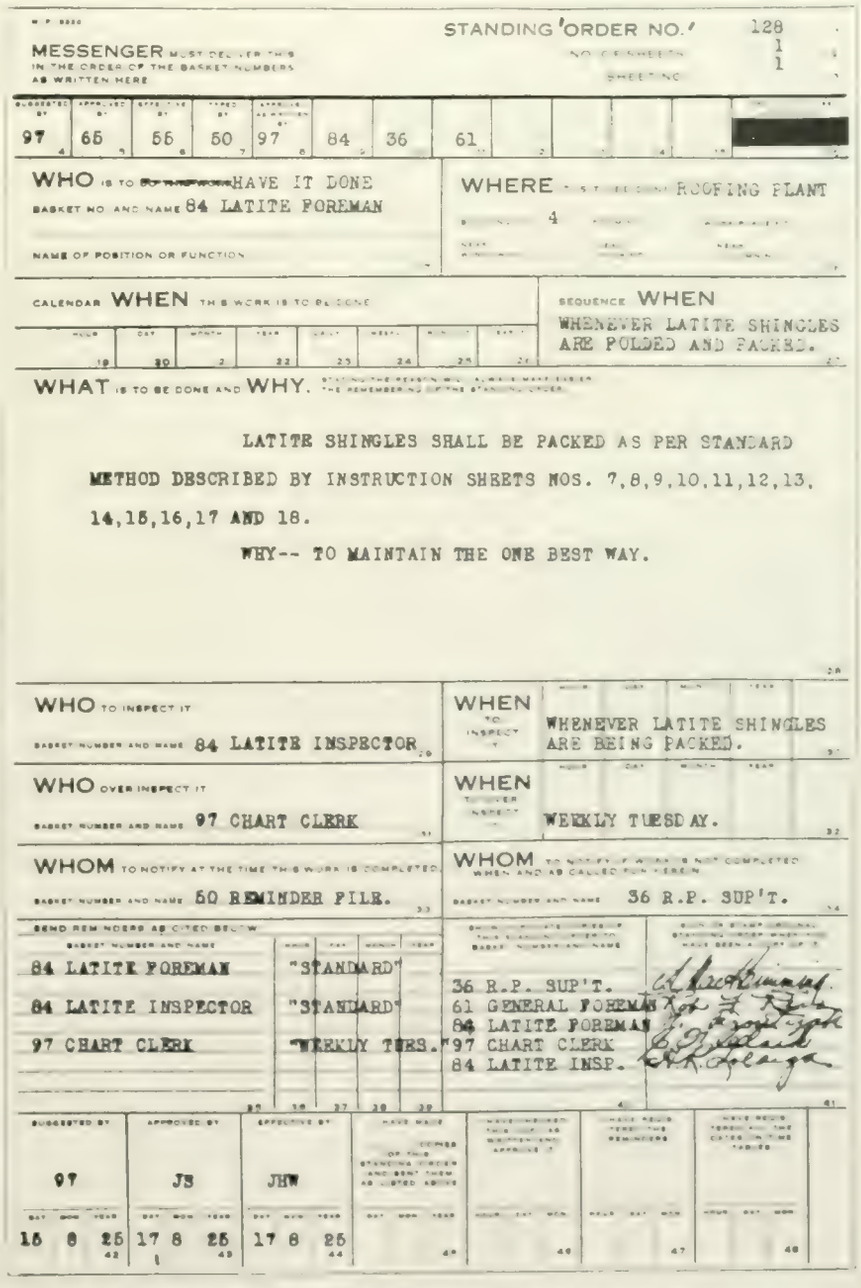
The rate of output, loss of time due to delays, and percentage of waste from each machine used in the production of roofing materials are charted daily and each foreman inspects the charts covering the work for which he is responsible, giving us the reasons for the exceptional changes in rate of production. By such a method we have received many good suggestions; the variables of production are being brought out giving us the opportunity to study them and, above all, the continued inspection and analysis of these charts has done much to stimulate interest in reducing waste of time, effort and materials.

These graphical records have also enabled us to study the learning periods of untrained crews and those of individuals as well. Fig. 5 shows the progress, during the learning period, of two crews of four men each employed in the folding of 16" Latite shingles. The lower dotted lined graph represents the six-day progressive average of the rate of output of a new crew immediately after the new methods of feeding and packing were installed but there was no elasticity between the feeding and heating operations as described in a previous article. Some time later when the above elasticity was provided a new crew was added to this work and its performance is represented by the smooth line at a higher level.

A comparison of the two graphs will point to the facts that the last group made greater progress during the first six days of the learning period than did the crew which started some time before. This may be considered as another means of measuring the value of the results of our efforts to improve the methods during the period of August 1924 to May 1925. The relative smoothness of the line indicates clearly that we have ironed out" some of the "wrinkles" in the process by controlling a few of the variables which caused the fluctuation of the dotted line graph, and that we are approaching the conditions which would make these visual records truer representations of the learning process. In Fig. 6 is a learning curve of one of the new men recently employed on this work and is characteristic of the learning curves of other individuals.

Although the men do not complain of the fatigue caused by the first day's work, it is evident that the muscles, put into action, were not developed for the set of motions involved in the cycle. We have found that the men work as much as 25 per cent slower the second day in spite of the fact that they know much more about the work than they did the day before. The rate of output of the third day is usually higher than the first and from then on it is a matter of attaining automaticity.

These graphs represent the results obtained while other variables, aside from those of a psychological nature, entered into the process and though they may not be called true learning curves, they are indicative of the degree of perfection at which our methods stood and give us the valuable information as to what to


STANDING ORDER NO. 128

MESSENGER MUST DELIVER THIS IN THE ORDER OF THE BASKET NUMBERS AS WRITTEN HERE

97 65 56 50 97 84 36 61

WHO IS TO HAVE IT DONE
BASKET NO. AND NAME 84 LATITE FOREMAN
NAME OF POSITION OR FUNCTION

WHERE ROOFING PLANT
4

CALENDAR WHEN THIS WORK IS TO BE DONE
HOUR 10 DAY 30 MONTH 2 YEAR 22

SEQUENCE WHEN
WHENEVER LATITE SHINGLES ARE FOLDED AND PACKED.

WHAT IS TO BE DONE AND WHY.

LATITE SHINGLES SHALL BE PACKED AS PER STANDARD METHOD DESCRIBED BY INSTRUCTION SHEETS NOS. 7,8,9,10,11,12,13, 14,15,16,17 AND 18.

WHY-- TO MAINTAIN THE ONE BEST WAY.

WHO TO INSPECT IT
BASKET NUMBER AND NAME 84 LATITE INSPECTOR

WHEN TO INSPECT IT
WHENEVER LATITE SHINGLES ARE BEING PACKED.

WHO OVER INSPECT IT
BASKET NUMBER AND NAME 97 CHART CLERK

WHEN TO OVER INSPECT IT
WEEKLY TUESDAY.

WHOM TO NOTIFY AT THE TIME THIS WORK IS COMPLETED
BASKET NUMBER AND NAME 50 REMINDER FILE.

WHOM TO NOTIFY IF WORK IS NOT COMPLETED WHEN AND AS CALLED FOR HEREIN
BASKET NUMBER AND NAME 36 R.P. SUP'T.

SEND REMINDERS AS CITED BELOW

| BASKET NUMBER AND NAME | | BASKET NUMBER AND NAME | HAVE BEEN ADVISED THAT THIS STANDING ORDER WAS CANCELLED |
|---|---|---|---|
| 84 LATITE FOREMAN | "STANDARD" | 36 R.P. SUP'T. | |
| 84 LATITE INSPECTOR | "STANDARD" | 61 GENERAL FOREMAN | |
| 97 CHART CLERK | "WEEKLY TUES. | 84 LATITE FOREMAN | |
| | | 97 CHART CLERK | |
| | | 84 LATITE INSP. | |

| SUGGESTED BY | APPROVED BY | EFFECTIVE BY | HAVE MADE (NUMBER OF THIS STANDING ORDER AND SENT THEM AS LISTED ABOVE) | HAVE MADE THESE ENTRIES ON THIS STANDING ORDER AND WITHDRAWN AND APPROVED IT | HAVE MADE THESE TIME REMINDERS | HAVE MADE THESE ENTRIES ON THIS STANDING ORDER AND CANCELLED IT |
|---|---|---|---|---|---|---|
| 97 | JS | JHW | | | | |
| DAY 15 MON 8 YEAR 25 | DAY 17 MON 8 YEAR 25 | DAY 17 MON 8 YEAR 25 | DAY MON YEAR | DAY MON YEAR | DAY MON YEAR | DAY MON YEAR |

FIG. 4 STANDING ORDER FOR MAINTENANCE OF STANDARD METHODS OF PRODUCTION

expect from an inexperienced crew or individual.

### RHYTHM AN IMPORTANT FACTOR

The effect of rhythm on some of the operations is being observed and it has been found that the noise produced by the stroke of the die in the Latite folding machines gives rhythm to the operator's motions.

During the learning period the new worker feeds

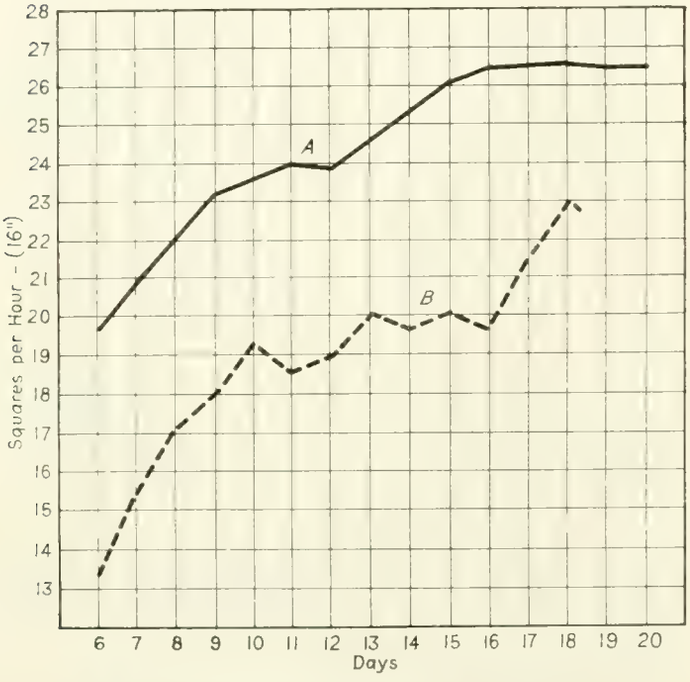



FIG. 5 PERFORMANCE OF NEW CREWS DURING LEARNING PERIOD

the shingle folding machine relying wholly on his sense of vision. After attaining automaticity in the method the sound serves as a means of synchronizing his motions with the movement of the die in the machine, and consequently the greater part of his work is accomplished without the use of his eyes.

This type of machine is now being redesigned and though a smooth running machine is desired, particular care has been taken to maintain the intermittent sound as one of its characteristics.

### EVALUATING RESULTS

The effect which any activity has on the prosperity of an industry is undoubtedly the most desirable criteria by which to measure the value of the results obtained. But the solution of the problem is made impossible by the number of factors which influence prosperity, and by our inability to determine the effect of any one of them. The most common procedure is to consider each operation by itself and then show "how" and "how much" the direct labor and material costs have been, or can be, reduced by the introduction of better methods and equipment. This system is inadequate for the reason that it does not give a complete measure of the effects which the changes have on direct labor and material costs, both of which can be reduced to the detriment of the industry.

The methods adopted by us permit an analysis of this problem from the point of view of reduction of waste, equipment, materials, and labor.[2] Our efforts in reducing the first two classes of wastes are measured by the usual simple methods, while the results of our attempt to reduce labor waste are measured by a monthly comparison of the labor input and production output.

The total number of man-hours for which we pay is our basis of measurement of the labor input. Thus, by the consideration of all of the labor throughout the plant we are able to judge whether or not our work of reducing wastes in labor in certain operations has had any effect in getting the men to take greater interest in the methods of doing their work, which would bring about the reduction of labor waste on their own account. This improvement in the general attitude and action of the workmen has taken place and it is considered one of the most valuable results of the work.

To measure the production output of the principal products an orbitrary unit was established which made

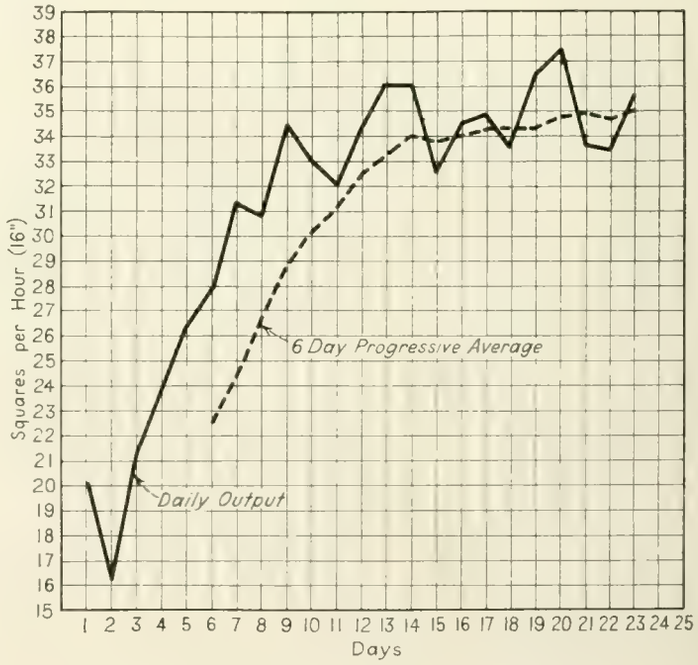



FIG. 6 LEARNING CURVE OF ONE OF THE NEW MEN

it possible to include at least 80 per cent of the products measured by weight and over 90 per cent of those measured by count. There are, of course, products which require more labor effort per unit of production than others but the proportion of the various products to each other remains fairly constant throughout the range of output.

Our work was started in April 1924 and, since then, the output per man-hour has made a practically continuous rise as shown by graphs 2 and 3 in Fig. 7. Before that time the rate of output remained practically stationary except for variations due to fluctuations in the volume of business.

[2] See Bulletin of the Taylor Society, December 1925.

The reader will note that the output per man-hour follows generally parallel to the monthly production but that the gap between them is gradually widening. The marked increase in output per man-hour shown by the last six months charted is due largely to the methods which have resulted from our efforts to reduce labor waste on the shingle packing processes, which were installed in June 1925.

Since fixed items such as watchmen, firemen, oilers, mechanics, foremen and similar jobs are included in the total man-hours, the output per man-hour is not a true measure of the labor efficiency of the entire plant unless it is considered in conjunction with the volume of output. A second chart, Fig. 8, was devised to show how much the increased rate of output is traceable to the increase in volume and to the result of our efforts to reduce labor waste.

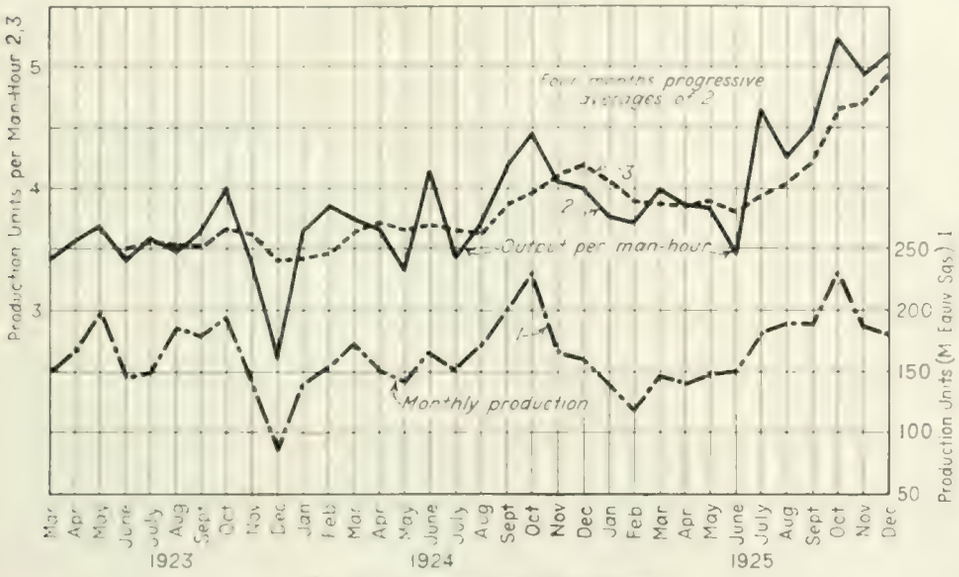



Fig. 7 Output Per Man-Hour

Assuming that a plant always operates at the same degree of efficiency, the relation between production output and total man-hours required for this production can be expressed by the general equation, $y = Mx + b$ where $y$ represents the total man-hours required to produce $x$ units; $b$ the fixed man-hours such as watchmen, etc.; and $M$ the number of man-hours of productive labor required per unit of output. This value, $M$, is constant for a plant which maintains the same degree of efficiency.

The figures covering the last ten months of 1923 were examined and plotted to show the relation between output and man-hours. The value of $b$ for this period averaged close to 10,000 man-hours per month. The maximum for any month was about 11,000 man-hours so that this item was fairly constant. Since then, this value has not noticeably increased and we are looking forward to a reduction of this item.

Line $B$ ($y = 0.218x + 10000$) was drawn to express with reasonable accuracy the relation between man-hours and production output and it may be considered the base line from which any change in labor efficiency in the direct production operations may be measured. Hence, all points which fall below line B indicate that our activities have caused an improvement over the average conditions in 1923. The determination of the relative amount of improvement represented by any point below this line is aided by the lines C, D and E (with lower values of $M$) indicating degrees of efficiency higher than that shown by the 1923 figures. The reader will note that all points for 1925 are well below the points of 1923 and generally below those of 1924, in spite of the fact that the volume of output was lower month for month than in 1924.

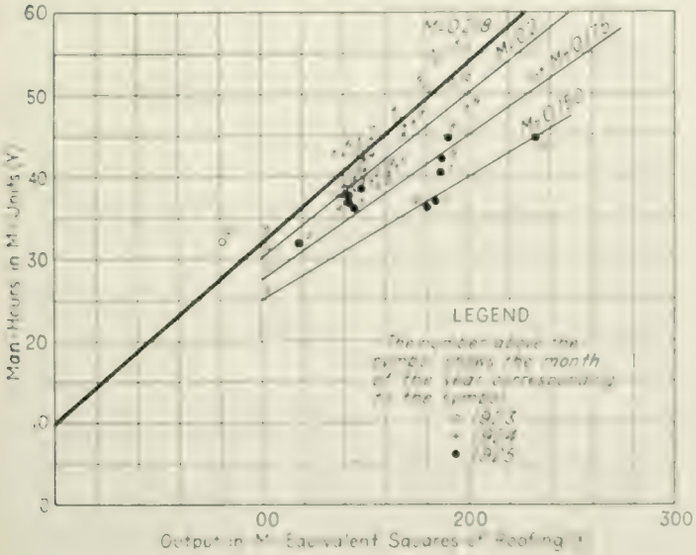



Fig. 8 Relation of Labor Input to Production Output

We are satisfied that these charts present a picture of the savings which have resulted from the reduction of waste of labor effort through the work described by the writer in this and previous articles. The increases in plant efficiency and in earnings of the worker are beyond doubt but the question relative to the "return on the investment" from the point of view of co-operation as well as plant economy is still unanswered. The following statement of John H. Weller, manager of the Maurer Plants of Barber Asphalt Co., will answer the latter phase of the question.

"While we are not at liberty to give actual values of savings in dollars, we can say we estimate that the value of the savings on labor cost alone, amount at present, on the average month's business, to about four times the current monthly expenditures for carrying on this work."

The activities of management towards promoting co-operative effort is one of the greatest factors in the conduct of an industry. At Maurer, the response to such activities may now be judged.

# Effect of Knots on Strength of Bracing for Carload Freight

By R. P. JOHNSON

*Engineer, U. S. Forest Products Laboratory*

A PIECE of car bracing has no definite, fixed amount of strength regardless of how it is used. Its amount of strength and the service it is good for depends largely on how it is placed with reference to the knots it contains. In order to know how to place bracing with reference to knots, we must first see how a knot injures the strength of beams. If we test the wood of a knot, we find it harder, stronger, and heavier than the surrounding wood. We might, therefore, expect it to be an asset to strength, yet we know that it is a liability. Why? The answer is not far to seek, because one of the most prominent characteristics of wood is its difference in strength lengthwise of the grain and across the grain.

### STRONGER WITH THAN ACROSS GRAIN

In tension, wood is from 25 to 50 times as strong in the direction of the grain as across it, depending on whether it is green or dry. In compression, wood is about ten times as strong with the grain as across it. Let us see how this characteristic of wood explains the injurious effects of knots on the strength of a beam when used as a car brace or for any other purpose. A knot is formed by wood fibers of the main body of the tree running out into a limb, and the other fibers develop cross grain in passing around the knot. Consequently, forces acting along the grain of the main body of the beam act across the grain of the wood in and surrounding the knots.

Now, when a load comes against a brace, tending to throw it into a bow shape, the side of the brace away from the load is stretched, or thrown into tension along the grain, while the side next to the load is shortened, or compressed along the grain. That is practically the whole story of the bending of a beam. Thus the lengthwise tension and compression of the brace act on the wood of a knot in its weakest direction, that is, across the grain. Even the strength which wood has across the grain is practically destroyed in knots by the checking which almost invariably accompanies drying. This is illustrated in Fig. 1. Consider the piece illustrated in the picture to be loaded at the top as indicated, and supported at the two ends. The top of the beam will be shortened or compressed and the bottom stretched or under tension. The relative direction of the forces set up inside the piece are shown by arrows. Note that the forces are acting along the grain, or in the strong direction of the wood, in the main part of the beam, and almost directly across the grain, or in the weak direction of the wood, in and around the knot. We see, therefore, that the cross-grain in and surrounding a knot is what causes injury to the breaking strength of a beam, and since the difference in strength along and across the grain is so much greater in tension than in compression, knots on the tension side are about twice as injurious as they would be on the upper or compression side. Therefore, turn the knotty face of a car brace *toward* the load and not away from it.

"It sounds good, but it is all theory," you may say.

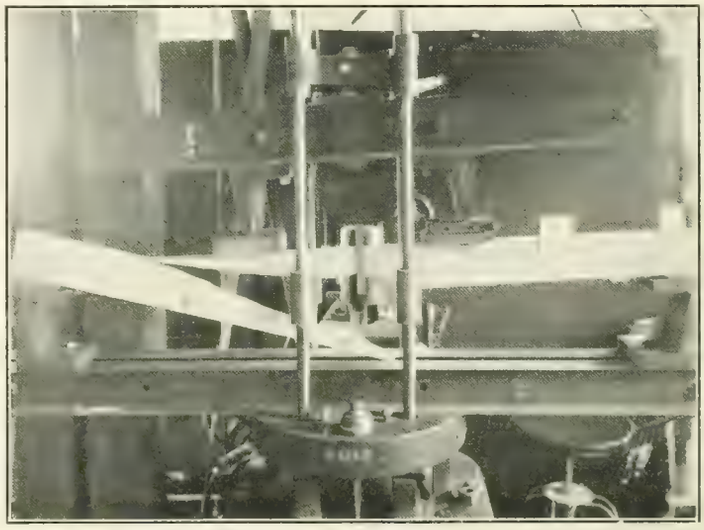


FIG. 1 TESTING STRENGTH OF BRACING
The beam with a knot at the bottom broke at 1030 pounds.

Now, suppose we subject it to a practical test as was done before a group of claim agents of the American Railway Association at the Forest Products Laboratory. Three 2 by 4s were cut from the same plank, one clear and two with knots of about the same size on the edges. One was tested with the knot on the compression face and one with knot on the tension face, and the results compared with those of the clear specimen. Each piece was put into a testing machine as shown, with its ends supported and the load applied on the upper face through the I-beam and pressure blocks shown. The beam with the knot on *top* broke at a load of 1670 pounds. The beam with the knot on the *bottom* broke at 1030 pounds. The *clear beam* broke at 2430 pounds. So the knot on the top or compression face caused the beam to break under 760 pounds less load than was carried by the clear beam, while the knot on the bottom or tension face caused the beam to break at 1430 pounds less load than the clear beam carried. That is, the loss in strength from the knot on the bottom or tension face was approximately twice that from the knot on the top or compression face, as our theory stated would be the case.

The theory of the influence of knots on the breaking strength of beams is based on the results of many tests made at the Forest Products Laboratory.

# Operating and Turnover Ratios

## In the Financial and Industrial Investigation

By ARTHUR ANDERSEN

*Arthur Andersen & Co.*

IN a former article[1] the general use of ratios in financial analysis was shown, and some detailed discussion was given of the significance of various balance sheet ratios. But the most interesting type of analysis from a going business viewpoint is that given by a study of turnover ratios, which as a whole expresses the relationship between operating results and the capital employed. In other words, a comparison between profit-and-loss figures and balance-sheet figures.

Turnover ratios as related to current assets are affected little by inflation and deflation, unless these movements are violent. Both sales and inventories are directly affected by changes in price levels and the ratio is affected but slightly in enterprises which have reasonably rapid turnover. It is only in industries which have very low turnover, where the process of manufacture extends over a period of from six months to one year or more, and when inflation and deflation occur very suddenly, that the ratio is noticeably affected by this factor. Ordinarily the relationship between purchase and sales prices remains reasonably constant.

Turnover ratios over a period of time reflect improved or less effective use of capital resulting from management and business conditions. If an enterprise has been unsuccessful, it furnishes a basis for study to determine whether capital has been inefficiently employed or whether there is insufficient general demand for the product to enable operations upon a successful basis.

It is a self-evident condition that a capital of $1 turned twice will yield the same amount of profits as $2 turned once and the rate of return on investment will be twice as great. Under competitive conditions, $1 turned twice can do business upon one-half the margin of profit and yield the same rate of return on investment as $2 turned once. Ordinarily, operating ratios which deal with margins and control of expenses are given more attention in analyzing the trend, success or failure of an enterprise. Turnover ratios are equally vital in their effect on the relationship of profits to a reasonable return on investment and in the ability to reduce profit margins in times of keen competition. Effective turnover of capital and profits are each essential factors in the determination of a reasonable return on investment. Efficient or inefficient use of capital, which is reflected in turnover ratios, has equal influence in determining the return on investment as the percentage of profits realized.

### Turnover of Total Capital Employed

The ratio of sales to total assets used in producing sales reveals the turnover of total capital employed. Total capital employed is represented by the assets of an enterprise irrespective of the source from which the capital is obtained. The portions of capital obtained through credit, short and long term loans, and investment do not alter the amount of capital employed. The assets of an enterprise ordinarily include cash, receivables, inventory, deferred charges, plant and frequently intangibles. Receivables, inventory and plant are usually major items. Extraneous investments in securities or properties having no connection with the business should be eliminated in ascertaining turnover, as such assets yield income independently from income of the business.

Normal turnover, in accordance with the characteristics of each industry, fixes the relationship between turnover ratio and operating profit margin so that a reasonable return will be realized on capital employed. Operating profits as used in this sense are net profits from the business available to pay cost of financing and yield return on net worth. An enterprise, marketing large units or higher priced products, will have a lower turnover than one selling small units or lower priced products. A lower turnover must of necessity have a higher profit margin in order to realize a fair return on the investment.

### Turnover of Receivables

The fundamental relationship between turnover and profit margin constitutes the basis by which operating results are to be judged. It is the starting point for determining the weaknesses or strength of an enterprise. The extent to which weaknesses in turnover have contributed to an insufficient return may be ferreted out through a process of elimination, by applying the turnover ratio to the principal assets comprising capital employed. These ordinarily are receivables, inventory and plant.

Turnover of receivables is revealed by the ratio of charge sales to trade receivables. Cash sales and receivables other than from trade should be eliminated

[1] See MANUFACTURING INDUSTRIES, May 1926, page 351. For other articles on this subject see December 1925, page 325; January 1926, page 17; February 1926, page 113; March 1926, page 201; April 1926, page 277; May 1926, page 351.

as they are unrelated to credit extended on sales. In case of a seasonal business, the receivables must be averaged in order to obtain a more correct turnover for each of the periods under consideration. The turnover may be shown in the usual way in terms of sales times receivables as for example 5 to 1. Another form of expressing it is by showing the number of days' sales carried in receivables as, for instance, the receivables are equivalent to 45 days of charge sales. This is obtained by dividing the receivables by the average charge sales of one day's business.

The ratio of total charge sales to average trade receivables gives the composite turnover of all receivables. In a business making all sales upon uniform credit terms, and selling over limited territory, this composite ratio is often sufficient for general analysis of a business. When sales are made in many states and in different countries, and when varying credit terms are established in different territories and on different commodities or departments, the composite ratio is hardly sufficient in determining whether turnover has been favorable or unfavorable. The ratio must then be applied to groups of receivables arising under different credit terms and in different territories.

The turnover ratio of receivables is significant in determining the effectiveness of the credit and collection department. A comparison of the rate of turnover with the usual terms of credit gives an indication in normal times of how rigidly collections are enforced in accordance with terms of credit extended. During periods of changing business conditions and periods of depression, credit departments are always confronted with increasing problems. Over such periods, the ratio is indicative of the general policy of credits and collections. The degree of caution with which credit has been extended, and the enforcing of collections, wield their influence in molding the ratio. The movement of the ratio over a period of years furnishes the key to changes in credit policies, to the ease of collections as affected by business conditions and to the efficiency of the credit and collection department in periods of depression as well as in normal times.

### Turnover of Inventory

The benefits of a high rate of turnover, in contrast to a low one, are less collection expense, less possibility of bad debt losses, and decreased cost of financing. The longer an account is carried, and the longer collection effort is applied, the greater the collection expense. The possibility of bad debt losses is increased because customers who do not pay promptly often drift into financial difficulties. Low turnover results in increased capital invested in receivables which increases the cost of financing. All of these factors converge into the final result of an increase or decrease in return on capital employed and in return on net worth.

Turnover of inventory may be stated on the basis of either sales or cost of sales. It is frequently shown in terms of sales as sales constitute the common basis for other turnovers, ratios, of expenses and margins of profits. The more correct basis, however, is cost of sales. The actual turnover is represented by the ratio of cost of sales to average inventory. The ratio on the basis of sales will usually show similar trends, but is less accurate because of the variations in profit margins. Under the retail method of accounting, the ratio of sales to inventory at sales prices gives the same turnover ratio as cost of sales to inventory at cost prices.

The composite ratio based on total inventory gives the turnover as a whole. More useful information is obtained by ascertaining turnover with respect to the various classes of inventory. The ratio of cost of sales to finished product gives the turnover of manufactured product or merchandise sold. The ratio of finished product to work-in-process gives the turnover of work-in-process. The ratio of total materials and supplies used to inventory of materials and supplies gives the turnover of raw materials and supplies. Ascertaining the ratio with respect to different kinds of products sold and principal classes of raw materials used leads to information on movement of stocks and the balance maintained in inventory in accordance with production and sales.

The turnover ratio of inventory over a period of years is of assistance in ascertaining the rapidity of realization, the policy with respect to advantageous purchasing, and alertness of the purchasing department in buying as warranted by current business conditions. Variations reflect primarily the efficiency in use of capital. By ascertaining the ratio by departments or on various classes of merchandise, information can be obtained on the extent of excessive stocks and on slow moving or obsolete goods. In a manufacturing enterprise, it assists in determining the degree of co-ordination between production and sales of the various products, and also the balance maintained in raw materials used in production. Very frequently, some materials used in manufacture are considerably over stocked while an insufficient quantity of others is carried. Surplus stock occasioned by advantageous purchasing is sometimes justified, but it has its dangers as well as advantages and can not form the basis of continuous policy. The foresight of a management is often revealed in the steadiness of turnover in periods of depression as well as in periods of advancing prices.

The advantages of rapid and efficient turnover are decreased cost in carrying inventories, less possibility of excess and obsolete stocks and minimum danger of loss from price declines.

### Turnover of Property Investment

Turnover of property investment is reflected by the ratio of sales to plant. This relationship may be shown by the ratio of sales in dollars, or by the ratio of sales in units to plant. The ratio of sales in dollars is more frequently used. During periods of inflation and deflation, the ratio based on sales in units supplements the ratio based on sales in dollars in that it eliminates the effect of and is uninfluenced by changes in price

levels. In this respect it expresses a more accurate relationship between sales and production and plant.

The ratio of sales to property invested over a period of years is of assistance in determining the general policy of plant expansion, the wisdom of plant expansion which has been made and the favorable or unfavorable competitive position of the enterprise. A study to ascertain the causes of fluctuations in the ratio will reveal whether plant expansion has been undertaken in order to supply permanent sales demands, or whether the construction expenditures were made in the ambition to expand relying upon ability to dispose of the added production. Expansion undertaken by the conservative management does not affect the ratio noticeably except perhaps for a very brief period during and following construction. Expansion based upon uncertain volume usually results in lowering the ratio for a considerable period following construction.

A period of several profitable years in succession is exceedingly tempting to the undertaking of expansion. This was well illustrated during the war period. The wisdom of such expansion is demonstrated in the ability to utilize subsequently the increased capacity and maintain the ratio of sales to plant investment. The ratio when compared with competitors will reveal a measure of competitive advantage or disadvantage which will have its effect in return on net worth.

### Ratio of Surplus Net Profits to Net Worth

The ratio of surplus net profits to net worth, when placed on an annual basis, expresses the earning power of a business from the viewpoint of stockholders. Although this, in itself, is not strictly a turnover ratio, it constitutes the basis for the relationship between turnover of net worth and surplus net profit margin. Normal turnover of total capital employed fixes its relationship with the ratio of operating profits. Total capital employed in this sense is total assets; operating profits are profits available for financing. After deducting from operating profits the cost of borrowed capital and income taxes, a comparable relationship exists between turnover of net worth and surplus net profit margin. The ratio of final net profits to sales must generally be sufficient, on the basis of normal turnover, to yield a fair return on net worth. The ratio of final profits to net worth is the final summing up of all turnover and operating ratios and reveals the success obtained through management in financing, turnover and operating.

The ratio of final net profits to net worth varies according to business conditions, competitive conditions, character of business, risks involved and management. A business well established and having stable conditions will realize a more uniform return and attract capital more readily than one that is new and easily affected by disturbances. New industries, such as the radio industry of to-day, are more speculative in character and must yield a higher return in order to attract investment. A succession of profitable years encourages expansion. Periods of depression bring keener competition forcing lower returns and often eliminating the less efficient.

### Ratio of Gross Profits to Sales

The ratio of gross profits to sales represents the spread between cost of goods sold and net sales. Fundamentally, this margin in competitive industry varies within a range which will yield to the average concern under average conditions a fair return on capital over a period of time. This is essential to the survival of a business. From the standpoint of the individual enterprise, the margin is set by competition. As competition becomes keener in proportion to demand, gross profit margins narrow. Increasing demand in proportion to supply tends to increase prices and profit margins. Each enterprise endeavors to dispose of the commodities at maximum prices consistent with volume and thus realize as high a gross margin as competition will permit. From the gross profits realized selling and general expenses and cost of financing must be paid. The balance remaining represents the return on investment.

The ratio in the case of merchandising or trading companies represents the spread between purchase cost and sales. It is the margin of the middleman as an agency in the handling of commodities from producer to consumer. Variations of the ratio in trading companies over a period of years are the result of business conditions, effectiveness of purchasing power and sales policies. Business conditions constitute undoubtedly the greatest factor in affecting demand for goods and thus influence gross profit margin continuously. Profit margins are under continuous surveillance by a management with the view of maintaining profitable turnover under existing business conditions. Purchasing power and changes in policies in purchasing and sales departments wield a lesser influence on the ratio of gross profits.

The ratio in the case of manufacturing companies represents the spread between manufacturing costs and sales. Cheaper production means lower competitive prices or larger profits. High production costs may mean competitive elimination.

In analyzing a manufacturing enterprise, some of the more important ratios concerning manufacturing costs are the ratio of total manufacturing cost to sales, ratios showing proportionate cost of materials, labor and factory expenses to total manufacturing cost, and the ratio of property expenses to property investment and to sales. Variations in the ratio of total manufacturing cost to sales are caused by conditions, competitive advantages or disadvantages, internal policies and disorders. The ratios showing proportionate cost of materials, labor and factory expenses often lead to information on material market and labor conditions. The factory expense ratio should ordinarily decrease with increased volume. Assuming approximately uniform general price levels, a reasonably normal relationship exists between property expenses, property

investment and sales. Property expenses include depreciation, insurance, taxes and repairs. Variations in these ratios over a period of years furnish a basis for study of the very vital issue of whether a concern can manufacture its product and market it at a reasonable profit.

### RATIO OF SELLING AND GENERAL EXPENSES TO SALES

The ratio of selling and general expenses to sales is significant of the control exercised over these expenses in relation to sales. Expenses constitute a first lien on gross profits and must be paid before arriving at earnings available for cost of financing and return on investment. Even in times of financial difficulties, expenses must be paid before bond interest, bond principal or stocks have any claim.

Fluctuations in the ratio over a period of years will reflect the change in relationship of expenses to sales as caused by business conditions. Sales are subject to continuous fluctuation by reason of changing demands and by the adoption of sales policies in accordance with changing conditions. Expenses, on the other hand, are reasonably fixed. When expenses are once increased in order to take care of sales expansion, they can not be so readily contracted when sales volume diminishes. The ratio of expenses to sales should ordinarily decrease with increased volume. If the expense ratio increases with increased volume, there is usually a lack of co-ordination of expenses with sales and an indication of weakness in management. The increase in expense ratio to sales during and since the deflation of 1920 and 1921 is the most outstanding illustration of the effect of business conditions.

### RATIO OF OPERATING PROFITS TO NET SALES

Operating profits constitute net profits, exclusive of income from investments and non-operating sources, available for interest on borrowed capital and income taxes. Income from investments and non-operating sources are extraneous to the particular business under consideration and cannot be included in the relationship of operating profits to sales. Interest on trade receivables and purchase discounts are elements of operating profits. Because of usual concern in the ratio of profits to sales before interest received and purchase discounts, operating profits are generally shown both before and after these items. Federal and state income taxes are shown as deductions with interest paid for the reasons that extraneous income and interest paid are included in computing the tax and, in theory at least, income taxes constitute a sharing of profits.

The ratio of operating profits to net sales represents the operating margin realized on sales. It is complementary to the turnover ratio of total capital employed both borrowed and invested. The turnover of total capital employed fixes the relationship with operating profit margin so that a fair return is realized on capital employed. The higher the characteristic turnover of capital in an industry, the lower the characteristic profit margin. This ratio is not influenced by the manner of financing, except in-so-far as a certain ratio between borrowed capital and stockholders' equity is normal for a particular industry. The greater the average stability of earnings the greater will normally be the proportion of borrowed capital and the lower will be the average ratio of operating profits. From operating profits, the cost of borrowed capital is paid, leaving the remainder as a return on stockholders' investment.

### RATIO OF SURPLUS NET PROFITS TO SALES

Surplus net profits represent the final net profits remaining as return on investment. Its ratio to sales shows the percentage realized as net profits and is the final result of all other operating ratios. This ratio is complementary to the turnover of net worth in relation to sales. Normal turnover of net worth to sales determines the ratio of surplus net profits to sales necessary to yield a fair return on investment which is expressed by the ratio of net profits to net worth. This relationship is fundamental to the permanence of an enterprise.

Variations in the ratio of surplus net profits to net sales over a period of years result from the same causes as influence the ratio of operating profits which are business conditions, competitive conditions and management. It is also influenced by the additional factor of cost of borrowed capital. A strong financial structure can borrow money at less cost than one less favorably financed and thus increase its net profits.

It is evident that the analyses cited are just as applicable by the management in directing the course of its own business as they are by outside investigation in showing what the course of the business has been in the past.

With the movement of business cycles, an enterprise will experience normal times, periods of high earnings and periods of depression. During years of normal and high earnings, the management must conserve its resources, and keep a tight rein of control over operations and expenditures if it is to fortify itself to weather the trials of less favorable conditions. Careless financing and dissipation of earnings through dividends in successful years multiply the problems and usually result in financial difficulties in periods of depression. The managements of all sizable enterprises are constantly seeking improvements and greater efficiency which will enable marketing a better product or at less margin as compared with competitors. They cannot afford to overlook a single means of control. The enterprise that stands still and is content with itself soon finds itself in competitive disadvantages which result in eventual elimination. Business is characteristic of the individual. Survival, comparative position and success are the rewards of a definite constructive financial and operating policy, which reveals itself through intelligent analysis and the use of analytical findings to better the status of the business and the industry.

# Knitting Plant Material Control

## Methods Used to Record and Schedule All Materials

By HERBERT C. GATES

*Superintendent, Underwear Department, Otis Company,*
*Formerly Head of Planning Department, The William Carter Company*

IN a knit underwear mill one of the most important records is that of the knit cloth on hand. This paper briefly covers the manner in which an accurate daily inventory of knit cloth is maintained in several mills.

The first main purpose of cloth stock control is to provide the planning department with a perpetual daily inventory of cloth by fabric and head size, so that the proper cutting up orders can be issued with the assurance that the right sizes and quantities of cloth will be on hand when wanted. The second main purpose is to provide the cost department with the necessary record of cloth to be charged into process accounts.

### Green Cloth Division

Some mills carry as many as 150 active cloth fabrics, many of which because of the peculiarities of their bleach, color, dye or tint require either separate processing or groupings with other fabrics to make up complete batches. This necessitates a small stock of unprocessed cloth which we call "green cloth."

The record of this green cloth is maintained by posting to it daily the summary of all rolls of cloth cut off the knitting machines each day, Fig. 1, and subtracting from it daily the record of cloth processed each day, Fig. 2.

### Finished Cloth Division

The record of this cloth starts with a physical inventory of the cloth on hand in the cutting department. These physical inventories are taken twice a year, and we seldom find it necessary to take further physical inventories for check up purposes.

Starting with a new physical inventory at the beginning of a period we set up this inventory on a set of cards, Fig. 8, in the cutting room office. Each card covers a certain head size of a certain fabric. As each day's bleach and dye records, Fig. 2, come through, the total poundage of each head processed is posted to the proper card and the balance carried forward. Since each batch of cloth processed goes directly to the dry room and thence to the cutting room, the bleach and dye record is equivalent to a receiving record.

At the end of each day a summary of the day's cloth cutting is made, and this cloth used record is posted to the cloth inventory as a deduction.

A copy of the summary sheet of cloth used for each day goes to the cost department, which assigns the proper cost values for each fabric and then charges the garments in process-material account with each day's cloth cuttings.

### How the Cloth Used Reports Are Obtained

Each day's cutting orders are issued by the planning department from the home office, and consist of a certain number of individual shop orders, Fig. 3, each calling for a certain number of dozens of various fabrics, styles and sizes. The shop order unit is in most cases five dozen, and the average number to a group is 20 dozen. On the back of each ticket group the planning department lists the cloth number, the head sizes required to cut the order and the estimated poundage required on each head size.

As these tickets are given to the cutters, the cloth men take the necessary cloth from the cloth stock room and feed it to the cutting tables. As each roll of cloth is taken from the cloth room the head cloth

CLOTH KNIT

MILL NO. 5 SIZE OF HEAD DATE 1/2/23

| Cloth No | 7½ | 8 | 8½ | 9 | 9½ | 10 | 10½ | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 26 | 27 | 28 | 29 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4562 | | | | | | | | | | | | | 500 | 500 | 420 | 4 | 46 | 40 | | | | | | | | 3206 |
| 4659 | | | | | | | | | | 104 | 300 | 420 | 436 | 450 | 600 | 500 | | | | | | | | | | 3310 |

FIG. 1 SUMMARY OF ALL ROLLS OF CLOTH CUT OFF THE KNITTING MACHINES EACH DAY

man records the fabric, head, weight, and roll number on the cloth issued sheet, Fig. 4. This information is obtained from the roll tag attached to the roll of cloth, Fig. 5. As the rolls of cloth are cut up the tags are removed by the cutters and thrown into a box under each cutting table.

The rolls of cloth which are only partially used are laid one side, and at the end of the day's cutting are

BATCH ORDER No. ..84.. BATCH ORDER No

Date made out Date made out

Process date Process date

Delivery date Delivery date

MILL NO. 6

| Quality | Siz | Rolls | Weight | Total | Quality | Siz | Rolls | Weight | Total |
|---|---|---|---|---|---|---|---|---|---|
| 520 | 18 | 696.1 | 24 | | | | | | |
| | 18 | 696.2 | 26 | 50 | | | | | |
| | 19 | 6[illegible]1 | 30 | | | | | | |
| | 19 | 696.[illegible] | 32 | | | | | | |
| | 19 | 7[illegible]4 | 35 | 101 | | | | | |
| 5077 | 18 | 1[illegible] | [illegible] | | | | | | |
| | 18 | 1[illegible] | [illegible] | 74 | | | | | |
| | 19 | 7246 | 30 | | | | | | |
| | 19 | 7[illegible]8 | 41 | 82 | | | | | |
| | 20 | 7[illegible]1 | 42 | | | | | | |
| | 20 | 7[illegible]7 | 43 | 85 | | | | | |

FIG. 2 DAILY RECORD OF CLOTH PROCESSED

reweighed by the cloth men, the new weight being entered against the original entry on the cloth issued sheet, and at the same time the new weight marked on the roll tag. These rolls are then returned to the cloth room, and all roll tags from each cutting table collected. Each tag is checked against its original entry on the "cloth issued" sheet, and in the case of the rolls returned to the cloth room the difference between the original weight and the reweighed weight is extended on the sheet to complete the record of cloth used. Each roll of cloth issued to the cutters must show either a corresponding roll tag at the end of the day or a reweighed weight. These individual sheets are summarized on a cloth used sheet, Fig. 6.

Firsts Seconds Shortage

Qty. 15 Size 4 Article 679

| 1145 | Operator's Number | 1145 | 334079 | 15 |
|---|---|---|---|---|
| Box | | Box | 334079 | 15 |
| Steam | | Steam | 334079 | 15 |
| Fold | | Fold | 334079 | 15 |
| Inspect | | Inspect | 334079 | 15 |
| DrEnds | | DrEnds | 334079 | 15 |
| Label | | Label | 334079 | 15 |
| Merrow | | Merrow | 334079 | 15 |
| Shldr | | Shldr | 334079 | 15 |
| Trim | | Trim | 334079 | 15 |
| Cut | | Cut | 334079 | 15 |
| Mark | | Mark | 334079 | 15 |
| Edge | | Edge | 334079 | 15 |
| C & F | | C & F | 334079 | 15 |

FIG. 3 SPECIMEN OF INDIVIDUAL SHOP ORDER

A weekly inventory of all cloth on hand at the end of each week is taken from the cloth stock cards and forwarded to the planning department, where it is checked against a similar record and any discrepancies noted and investigated.

The record of green cloth described earlier in this paper is kept in the planning department. The record of finished cloth stock which the planning department maintains differs from the mill cloth stock record both in its purpose and in its workings. Starting with the physical inventory received from the mill, the

CLOTH ISSUED

10/26/25

| Roll No. | Quality | Head | Out Weight | In Weight | Total Used |
|---|---|---|---|---|---|
| 4435 | 4106 | 16 | 40 | ✓ | |
| 4436 | " | 16 | 38 | ✓ | |
| 4437 | " | 16 | 42 | 16 | 104 |
| 4520 | " | 17 | 43 | ✓ | |
| 4521 | " | 17 | 41 | ✓ | 84 |
| 4631 | 338 | 19 | 45 | 10 | |
| 4632 | " | 19 | 46 | 10 | 71 |
| 4734 | " | 21 | 43 | ✓ | |
| 4735 | " | 21 | 44 | ✓ | 87 |

NO 341 MILL 6 SIGNED [illegible]

FIG. 4 CLOTH ISSUED SHEET

daily batch reports are posted to the cloth record, Fig. 7, under the column "Cloth Received." A space is also provided for inserting the batch number.

The deductions to this record are made by subtracting the amount of cloth scheduled or estimated to be cut each day. As each day's cutting orders are made up in the planning department, the cloth required to cut them is figured, and this record constitutes our cloth scheduled. When the mill sends in their daily cloth used reports each individual item is compared with the original amount scheduled for that day, and the difference between the two quantities is entered on the record as a debit or credit to the balance.

This cloth record, therefore, serves three purposes as given in the following items:

Quality 3129/4-P-12L-TURN-HURRICANE

Head HEAD SPREAD FOLD P–23–21–16½

Lbs.

Roll No. 5690 Mach. No.

Knitter Date

Insp'tor Bleached Date

Remarks

**PAY CHECK**

Class CLASS 12-L PRICE $1.30

Knitter Date Lbs.

Head HEAD SPREAD FOLD P–23–21–16½ Roll No. 5690

Quality 3129/4-P-12L-TURN-HURRICANE

**KNITTER'S CHECK**

Quality 3129/4-P-12L-TURN-HURRICANE

Head HEAD SPREAD FOLD P–23–21–16½

Roll No. 5690 Mach. No.

Knitter Date Lbs.

FIG. 5 ROLL TAG

CLOTH USED

MILL NO. 6 SIZE OF YEAR DATE

| Cloth No | 7½ | 8 | 8½ | 9 | 9½ | 10 | 10½ | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 27 | 28 | 29 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4435 | | | | | | | | | | | | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | | | | | | | | | [illegible] |
| 4363 | | | | | | | | | | 200 | [illegible] | 342 | 76 | [illegible] | [illegible] | [illegible] | | | | | | | | | | 3765 |
| 541 | | | | | | | | | | | | | 600 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | | | | | | | | 4365 |

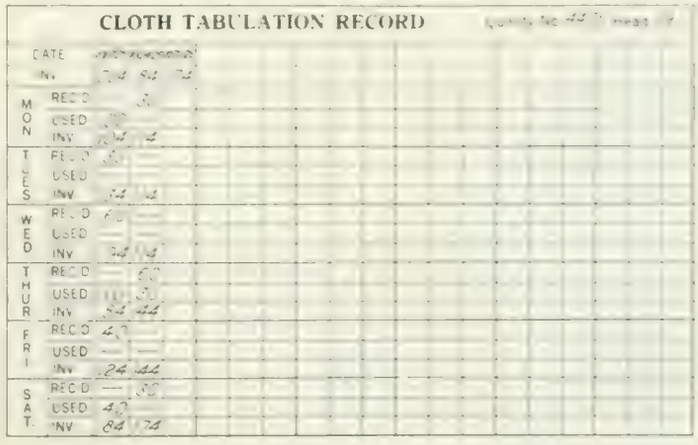
FIG. 6 SUMMARY OF CLOTH USED

1. Since we scheduled cutting orders from two to three weeks in advance of cutting dates, the balance of stock or shortage of stock on the record shows what quantities must be ordered knit.
2. By subtracting out the advance cuttings, an accurate record of the cloth on hand for any day can be determined.
3. By posting the differences between cloth scheduled and cloth actually used we are able to determine just how closely the mill is following our standard requirements of cloth.

Since our costs are based on a fairly close allowance for cloth per each dozen garments every larger or smaller than standard amount used is investigated, and if necessary, new test weights are taken.

The simplicity and directness of our cloth control methods are evident. Yet, they are complete enough to provide us with all the information we require for planning our orders, controlling our inventories and setting forth our daily stock conditions. The amount of time required to maintain all cloth records both in the mill and in the planning department averages three and one half to four hours a day for a plant cutting a daily average of 8000 pounds on 40 fabrics.

In addition to the control of cloth just described, similar control is kept of all important trimming materials in which the element of size or style enters. For instance, cuffs, shoulder straps, tubing, binding and facings must be ordered made up, issued for work, and reported used. The danger to be avoided here is that of too much detail. Any class of material on which the weekly requirements as to style or size are uniform can and should be controlled by the use of the weekly requisition slip of the finishing room foreman. This requisition is of course based on the current weekly production schedule and a copy of it goes


CLOTH TABULATION RECORD

| | | | | | | |
|---|---|---|---|---|---|---|
| DATE | | | | | | |
| No. | | | | | | |
| MON | RECD | | | | | |
| | USED | | | | | |
| | INV | | | | | |
| TUES | RECD | | | | | |
| | USED | | | | | |
| | INV | | | | | |
| WED | RECD | | | | | |
| | USED | | | | | |
| | INV | | | | | |
| THUR | RECD | | | | | |
| | USED | | | | | |
| | INV | | | | | |
| FRI | RECD | | | | | |
| | USED | | | | | |
| | INV | | | | | |
| SAT | RECD | | | | | |
| | USED | | | | | |
| | INV | | | | | |

FIG. 8 CLOTH TABULATION RECORD

to the cost department, for entry into their materials in process accounts.

Materials such as finishing threads, buttons, boxes, chemicals, labels, etc., are controlled by the weekly requisition slip as described in the preceding paragraph.

The control of yarn stocks for cloth knitting is maintained by posting the knitting orders to stock cards which show the balance of yarns on hand in cases, yarns en route and yarns on order.

(There are few problems in the control of manufacturing material so complex as the control of materials used in knitting mills. The variety of fabrics, vast number of individual orders varying by fabric, style, size, finish, etc., produce a condition difficult to control. Mr. Gates has used this method with success and satisfaction.—The Editors.)

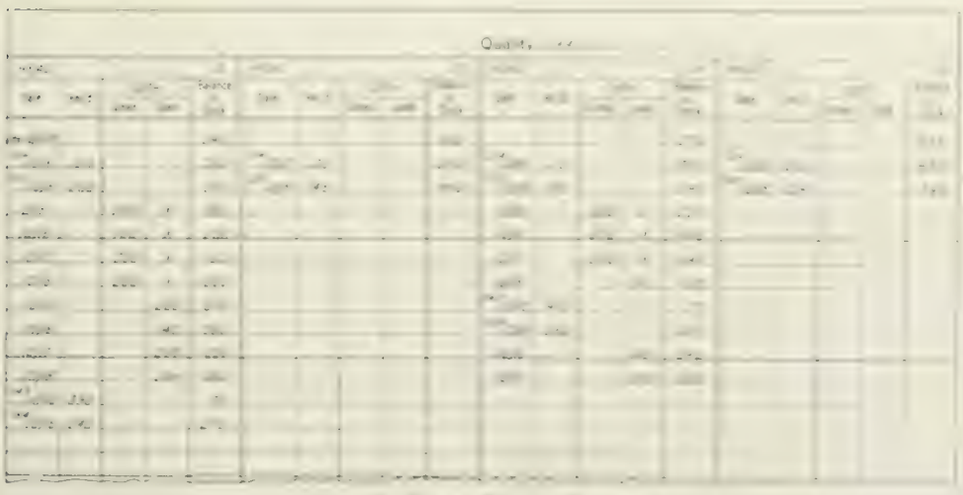


FIG. 7 DAILY CLOTH RECORD

# Real Relation of Wages and of Living Costs

By L. M. STOWELL

*Employment Manager, Detroit & Cleveland Navigation Co.*

DO, or should, factory wages vary from time to time with periodical changes in living costs, or can they be equitably set and largely maintained in spite of increased or lowered costs of living? When the selling price of manufactured goods rises, a reason is often given that the increased labor cost was responsible, as indeed it often is. But is this necessary? This question is frequently raised because, when a selling price is lowered, wages are more often lowered *after* the price cut than *before*, and are taken to be incidental rather than a direct cause in the rate of change.

The accompanying chart reveals a relationship between production, wages, sales and living-costs that can be nearly constant. It seems to show that a just wage scale may be maintained in spite of the extreme hills and valleys in the costs of living; that this scale may be set and continued at or near the prevailing average rate, and should be so established and maintained in fairness to both the employer and employee. In a given firm this unit rate of wage may not be determined or controlled by the costs of living, but rather by the constancy of the relationship between unit-production and unit-sales.

Exhibit 1 shows relations between employees, production, sales, wages, materials, other expense, profit, and the altogether result in cost of manufactured product and its influence on living costs.

Exhibit 2 shows a few more dollars in the pay-envelopes, but no more product. Once more the wheels turn until the fatal day when the general manager sees something wrong with the balance sheets and forthwith summons bookkeepers to find "what's the matter." They find the same general unit costs of material and other expense items, except labor, which is now shown increased. Also the same volume of sales is found at the same unit price, yet with lower profit. This situation has not entered into the previous hasty calculations and upsets the good results expected from the wage increase.

Finally, when realization comes that the market will not permit a higher selling price on the commodity manufactured, with its usual tendency toward ultimate increase in living costs, the inspiration comes to "stimulate production." Expanding this thought, as in Exhibit 3, it is observed that the same employees on increased unit production make possible the earning of their larger wage rate. Also, with more intimate understanding between selling and production forces, there follows the ultimate possibility of reducing the selling price of the product and the subsequent lowering of general purchase price to the consumer.

How does this work out in time of a general slump, with 10 or 15 per cent drop in living costs, as well as in the purchase price of essential raw materials? Is the continuation of this plan justified when everything else is lowered, so that the per-unit wage cost is low in proportion to costs of other commodities? History does not present available figures to guide us here, but common sense would seem able to determine a reasonable modification of any local application of a

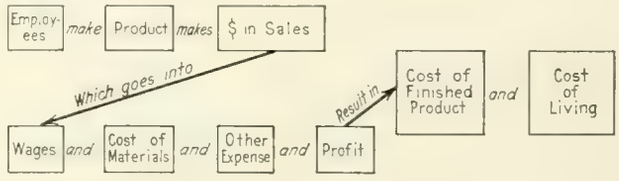



EXHIBIT 1

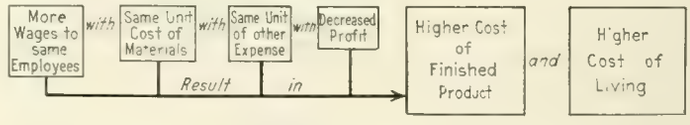



EXHIBIT 2

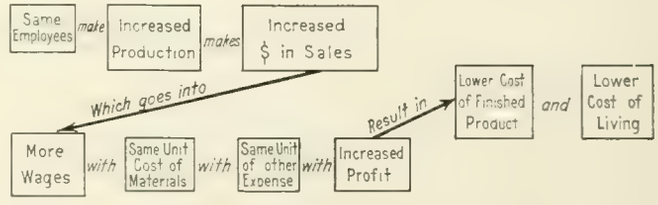



EXHIBIT 3

FIG. 1 RELATION BETWEEN WAGES, PRODUCTION AND LIVING COSTS

standard rule to meet any great variation in usual conditions.

It is found that where intimate co-operation exists between sales and production departments that a uniform sales and manufacturing schedule may be maintained to a surprising degree. The unit selling price may be somewhat shaded in extreme cases, but by close adherence to the sales standard it is found possible to maintain nearly and in some cases even to exceed the usual net receipts. As a result production registers normal or near normal.

Thus all hands are contributing of their best for a generally recognized common gain. The result is that work and quality are better and the unit production greater. This fact, together with the reduced costs of materials and other expenses, enables the unit of wages to be economically kept at high levels, with little real prospect that it will need to be reduced.

# $52,000 Saved in Non-Productive Work

## Small Economies Total Big Sums for General Electric

By V. V. HEIMSTREET

*Bureau of Methods, General Electric Company*

FROM the very first the General Electric Company has energetically supported the widespread attack being made upon industrial wastes by the Department of Commerce, acting in concert with a large number of manufacturers. Much of the saving already brought about by this co-operation has been in the field of production processes and simplification in sizes and kinds of products. But operations and materials used in the so-called non-productive departments of manufacturing plants can also be profitably studied and many substantial economies introduced.

The General Electric Company has already realized the possibilities for reduction of expense in its offices, service shops and warehouses. A slight change in the size or thread of a bolt, a change in arrangement of a printed form, a reorganization of a department, or the standardization of a simple clerical function often have far-reaching results on the yearly profit. A few actual cases are cited below.

### The Happy Medium in Economies

In looking for the $20,000 "leaks," most persons fail to recognize the items of $100, $2000, or $5000 which, if accumulated at the end of the year, would far outweigh the larger individual savings. On the other hand, in the endeavor to effect economy, everyone has a tendency to expend so much energy in ferreting out the obscure and indirect leaks, that they quite often miss the obvious; in other words, the search for details may cause the overlooking of glaring defects.

As an illustration, the General Electric Company until recently used two grades of internal envelopes. One type was of heavy weight material on which were printed the addresses of the various offices and plants, and the other was a plain, light-weight manila. By changing the heavy envelope (substance no. 28) to the weight of the plain envelope (substance no. 20), an annual saving of $4000 was realized.

Recently an employee made a suggestion that a different grade of tissue letter copy paper be used. The specifications were changed slightly and a tissue paper equally as good is now being purchased at a saving of $6000 each year.

For years a comparatively heavy-weight yellow paper was used for internal copies of customers' bills. Paper, when manufactured, is originally white and must be colored (increasing the cost) to secure other shades. Why yellow was used for a bill form instead of white, no one knew. Now a lighter grade of white paper is used, saving approximately $2000 a year. Furthermore, much better duplicator copies are made.

Many similar illustrations could be given. These are cited to show how three slight changes in specifications brought about a total annual saving of $12,000.

The commercial duplicator as a money saver is playing a very important role and has replaced hundreds of typists. General Electric shipping departments no longer rewrite requisitions when desiring additional copies; production departments no longer write out

Fig. 1. Centralized Duplicating Bureau

special shop orders on separate forms. The general office with its present staff of clerks could not possibly perform its work of issuing hundreds of reports, thousands of bills to customers, and so on, without this machine. (See Fig. 1.)

District sales offices no longer write an order to ship material from warehouses to customers, and then rewrite the same order in the form of a bill. Instead, they prepare the requisition in hektograph and use the original copy as a master for duplicating the customer's invoice. The duplicate (in hektograph) is sent to the warehouse where the superintendent notes the routing and number of boxes or packages that will be required and duplicates the necessary shipping labels, tags and the bill of lading, express or truck receipt, depending on whether the material is to be

shipped by freight, express or truck. A shipping label prepared in this manner is shown in Fig 2.

The labels are tacked or pasted to the boxes by an experienced selector and then serve as signals to the truckmen that the material is to be shipped. Boxes, crates, etc., are then carted to the loading platform and, upon shipment, the warehouse superintendent returns his copy of the requisition to the bill-

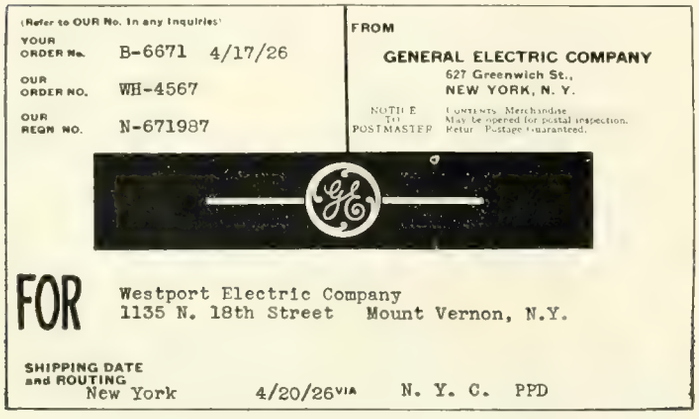

(Refer to OUR No. in any Inquiries)
YOUR ORDER No. B-6671 4/17/26
OUR ORDER NO. WH-4567
OUR REQN NO. N-671987
FROM
GENERAL ELECTRIC COMPANY
627 Greenwich St.,
NEW YORK, N. Y.
NOTICE TO POSTMASTER — Contents Merchandise. May be opened for postal inspection. Return Postage Guaranteed.
FOR
Westport Electric Company
1135 N. 18th Street Mount Vernon, N.Y.
SHIPPING DATE and ROUTING
New York 4/20/26 VIA N. Y. C. PPD

FIG. 2 SHIPPING LABEL MADE ON DUPLICATOR FROM SECOND COPY OF REQUISITION

ing department where it serves as authority to issue the invoice. The master is withdrawn from file, the bill number, date, and routing are filled in, in hektograph, and customer's bills and all internal copies are duplicated. (See Fig. 3.) At no time throughout the cycle is any data written more than once.

Not to be outdone, the General Electric service shops went several steps further. When a job is received they issue a combined receiving report, cost sheet, duplicate cost sheet, examination report, duplicate examination report and work order. All align with the customer's invoice, labels, shipping receipts, etc. When the job is finished one of the cost sheets (originally prepared in hektograph) is placed on a duplicator and from it are made the customer's invoice, shipping papers and all internal copies of the bill.

## REORGANIZATION OF DUPLICATOR WORK

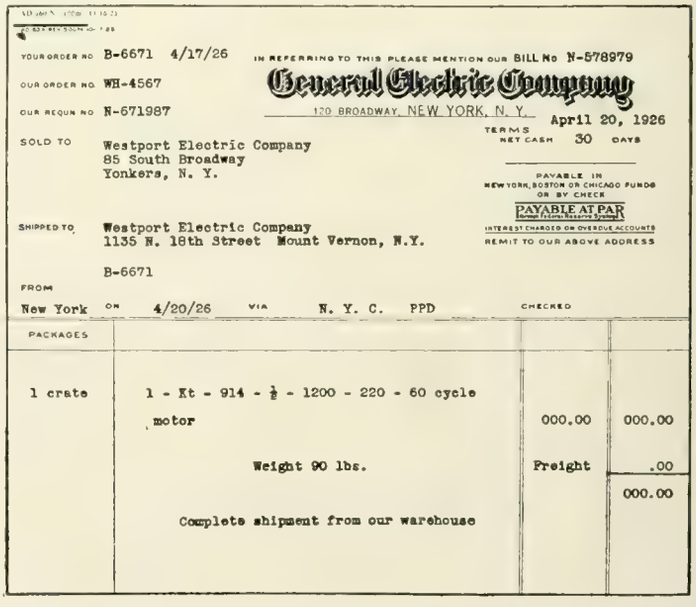
The application of the duplicator to so many different phases of General Electric work was so rapid that machines and operators were put to work in a very large number of departments. It was inevitable, however, that the majority of these should be idle many hours of the day. As a matter of fact, a review showed that at one plant alone there were 55 operators producing a total of 153,000 copies each month.

This number was cut down to 32 operators by creating a centralized bureau and, in spite of the reduction in the number of operators, the output increased to a total of 717,000 copies each month. The 23 machines thus made idle were transferred to other plants or sales offices and, as a result of this reduction, the plant in question realized an annual saving of $7500 in gelatine rolls alone. The total annual saving in machines, gelatine rolls, increased efficiency of operators, reduction in payroll, etc., amounted to approximately $40,000.

As an example of the varied types of work which the duplicator can be called upon to perform, there is the identification of blueprints mailed to customers. Approximately 6000 of these are mailed each week from Schenectady in connection with installation work. An average of 10 prints are prepared for each installation and on the back of each must appear the customer's name, requisition number, contract number, date of mailing, etc. Until recently this information was copied in longhand on the back of each print.

A form is now printed in hektograph and the customer's name, requisition number, etc., are filled in in hektograph. The information is immediately copied by the duplicator on as many copies of the blueprint as are required not only by the customer but also by the General Electric Company. The services of two employees were dispensed with as a result of this simple change. In addition, the possibilities of error have been minimized and the prints are prepared with greater speed.

Where changes in print specifications were necessary, it was the practice to prepare a form letter which accompanied each blueprint. This form is now printed in hektograph, specific changes are inserted in hektograph and the information is duplicated—again on


YOUR ORDER NO B-6671 4/17/26
IN REFERRING TO THIS PLEASE MENTION OUR BILL No N-578979
OUR ORDER NO WH-4567
OUR REQUN NO N-671987
General Electric Company
120 BROADWAY, NEW YORK, N. Y.
April 20, 1926
TERMS NET CASH 30 DAYS
SOLD TO Westport Electric Company
85 South Broadway
Yonkers, N. Y.
PAYABLE IN NEW YORK, BOSTON OR CHICAGO FUNDS OR BY CHECK
PAYABLE AT PAR
INTEREST CHARGED ON OVERDUE ACCOUNTS
REMIT TO OUR ABOVE ADDRESS
SHIPPED TO Westport Electric Company
1135 N. 18th Street Mount Vernon, N.Y.
B-6671
FROM New York ON 4/20/26 VIA N. Y. C. PPD CHECKED

| PACKAGES | | | |
|---|---|---|---|
| 1 crate | 1 - Kt - 914 - ½ - 1200 - 220 - 60 cycle motor | 000.00 | 000.00 |
| | Weight 90 lbs. | Freight | .00 |
| | | | 000.00 |
| | Complete shipment from our warehouse | | |

FIG. 3 CUSTOMER'S INVOICE DUPLICATED FROM ORIGINAL COPY OF REQUISITION AFTER THE LATTER IS COMPLETED

the back of each print. This method also has saved the time of two typists.

Not content merely with these accomplishments, however, the General Electric Company is continuing its study of labor-saving methods, because the size of the company and the diversity of its operations open the way to still greater possibilities of applying the duplicator to advantage, and bringing about other important economies in the offices and shops.

# The Guide to Latest Information

## One Hundred Best Selections for June*
## Notes on New Industrial Equipment

By THE EDITORS

OUT of the most recent issues of trade, technical and industrial magazines that contain articles dealing with subjects of value to manufacturing plant executives, and from the numerous books and pamphlets of a similar nature just published, the following items have been carefully selected and annoted. This index serves not only to bring to the plant manager's attention those books and articles which he may wish to read, but it also gives a running comment on the current trend of management thought and development.

Increasing attention to the successful management of the individual plant, to power generation, advertising, production control, employee training, health and safety, budgeting and to economic factors—particularly those concerning individual industries and the labor situation—are strongly evidenced.

Much useful industrial equipment for a wide variety of purposes is also being placed on the market.

## Industrial Buildings and Plant Maintenance

### Buildings and Equipment

**Fresh Air and Ventilation**

C.-E. A. Winslow. E. P. Dutton & Co., New York. 182 pp. $2. During the present century there has come an overwhelming revision of earlier viewpoints in regard to atmospheric conditions, in regard to their effect on human health. This volume reviews the subject rather for the general reader than the engineer or physiologist. It is based, however, upon an accumulation of newer knowledge which has found its vehicle for presentation in scientific treatises and technical monographs. The nature of the material in this book is indicated by the chapter headings, which are: Relations of the Atmosphere to Human Health and Comfort; What Constitutes Good Ventilation; How to Secure Good Ventilation; Special Problems of Factory Ventilation; Climate and Season and the Hygiene of the Skin. Index no. 658.25.

**Steel Windows in the Commercial and Industrial Building**

R. B. Howes. A description of types suitable for industrial construction. *Buildings* (Engineering and Contracting), Apr. 28, 1926, pp. 163-5. Illus. Index no. 658.24.

**Take Strong Position on Factory Sanitation**

B. K. Wilbur. Philadelphia candy manufacturers investigate conditions and adopt complete medical examination and free medical service as protection to the public and employees. Plan includes sanitary inspection and supervision of plants. *Candy Factory*, May 1926, pp. 74, 79. Index no. 658.239.

### Maintenance and Repair

**Maintenance of Factory Walls**

C. C. Hermann. Pointing, waterproofing and painting. *Machinery*, May 1926, p. 730. Index no. 691.4.

## Organization, Management and Administration

**Cadillac Keeps Strict Watch on Quality**

Lawrence P. Fisher, president of Cadillac Motor Car Co., describes the objectives in maintaining high standards of materials and [illegible] which the company insures their fulfilment. MANUFACTURING INDUSTRIES, June 1926, pp. 409-12. Illus. Index no. 658.562.

**Cost Estimates in Commercial Research (An Opportunity for Conservation)**

F. M. Becket. The author calls attention to the great losses due to failure to prepare proper and complete cost estimates for new [illegible]

[illegible]

**Effects of Applied Research Upon the Employment Opportunities of American Women**

Illustrative descriptions of changes due to research and their effect on the employment opportunities of women. Covers development of new substances, new branches of old industries, new raw materials, new methods, system of interchangeable parts, etc. U. S. Dept. of Labor, Bulletin of the Women's Bureau, No. 50. 54 pp. $0.10. Index no. 658.57.

**$52,000 Saved in Non-Productive Work**

V. V. Hemstreet. Small individual economies in envelopes, letter copy paper, forms, and in substitution of duplicator work for filling in of records, bills, shipping forms, etc., [illegible] Co. MANUFACTURING INDUSTRIES, June 1926, pp. 449-50. Illus. Index no. 652.

**Getting the Most Out of Your Machine Tool Dollar**

W. S. [illegible]. Machine tool equipment in an automobile plant becomes obsolete long before it wears out. Production engineer should keep in touch with all new machine tool developments and bring about the installation of new machinery as soon as it can be proved to be economical. *American Machinist*, May 6, 1926, pp. 697-8. Index no. 658.27.

**Influence of Design on Production**

Earle Buckingham. Steps in developing a new mechanism, designing to suit equipment available, eliminating extreme requirements for accuracy, sub-assemblies, standardization, preparation of drawings, jigs and fixtures, improvements of production methods. *Machinery*, May 1926, pp. 740-3. Index no. 658.575.

**Lumber**

Classification, size standards, selection for various purposes, inspection, cutting to eliminate waste. Revised Simplified Practice Recommendation, No. 16 (1926 issue), of the Elimination of Waste Series, U. S. Dept. of Commerce. 87 pp. $0.15. Index no. 674.

**Our Management Plan**

George F. Johnson. Plan of the Endicott-Johnson Corporation in which, during 10 years, the number of workers has doubled, the number of supervisors halved. *System*,

May 1926, pp. 633-6, 693. Illus. Index no. 658.5

**Scientific Foundations of Business Administration**

Edited by Henry C. Metcalf. Williams & Wilkins Co. Baltimore. 341 pp. $5. Fourth book in a series on human relations compiled by the same editor. The book is a compilation of lectures given under the auspices of the Bureau of Personnel Administration during 1924 and 1925. It represents a serious attempt to analyze the philosophical, biological, economic, and physiological foundations of business administration, and its basic administrative principles, and to apply them to practical business affairs. The material from the 24 co-ordinated conferences and the discussions which they developed has been compiled into the following sections of the present book: The Philosophical Foundations, by H. A. Overstreet; the Biological Foundations, by O. W. Holwell, the Economic Foundations, by Thomas Nixon Carver; the Psychological Foundations, by M. P. Follett; Basic Principles of Administration and of Management, by Harlow S. Person; Practical Applications of Scientific Principles to Business Management, by Henry S. Dennison; the Philosophic Foundations (concluding discussion), by H. A. Overstreet. The book also contains a selected reading list. Index no. 658.

**Testing Products from the User's Angle**

George E. Hagemann. General Motors Corporation has established a proving ground of 1125 acres, with 12 miles of roads, convenient to its Michigan factories, for exhaustive studies of all automobiles, to ascertain and develop the service qualities most in demand by customers. MANUFACTURING INDUSTRIES, June 1926, pp. 431-4. Illus. Index no. 658.57.

**Timely Guide to Manufacturing Control**

Joseph H. Barber. Describes the development, application and use of the valve and fittings index, which indicates business trends 3 to 6 months before they show in pig iron production. MANUFACTURING INDUSTRIES, June 1926, pp. 417-20. Illus. Index no. 338.97.

# Power Generation and Transmission

## Fuel

**Selecting the Best Coal**

H. C. Kenyon. Experience of the Standard Brick & Supply Co. is that the best coal for brick kilns is one giving a short flame, small amount of ash, and which is fine and clean when fired. *Brick and Clay Record,* Apr. 13, 1926, pp. 614-17. Illus. Index no. 621.18.

## Power Generation

**Advantages of Automatic Boiler Control**

H. K. Blanning. The author shows how automatic control compensates for the personal equation and gives a better perspective to the major operating results, as operators are relieved of minute details. *Power Plant Engineering,* Apr. 15, 1926, pp. 470-2. Index no. 658.261.

**Industrial-Boiler Efficiencies**

Samuel D. Fitzsimmons. Results obtained from two boilers at the plant of the Brown & Sharpe Mfg. Co. indicating the desirability of low furnace-draft velocities and more effective use of radiant heat. *Mechanical Engineering,* May 1926, pp. 412-14. Illus. Index no. 658.261.

**Modern Practice in Steam Flow Measurement**

Milton A. Goetz. Describes the selection and application of instruments to measure steam flow and the value of the resulting records in determining the cost of product. *Power Plant Engineering,* May 1, 1926, pp. 518-20. Illus. Index no. 658.26.

**Power for the Continental Fibre Co.**

Description of the equipment for the new industrial plant at Newark, Del. *Power Plant Engineering,* Apr. 15, 1926, pp. 460-5. Illus. Index no. 658.26.

**Recent Development in Mechanical Handling of Ashes**

George F. Zimmer. Description of a simple, durable and efficient system suitable for power house use. *Industrial Management,* Apr. 1926, pp. 242-4. Illus. Index no. 658.261.

**Southern Bleachery Installs Steam Plant in Hydro-Electric District**

Description of the new combined power and steam-heating plant of the Southern Bleachery, Inc. at Taylor, S. C. *Power,* Apr. 27, 1926, pp. 626-9. Illus. Index no. 658.261.

## Power Transmission

**Belting and Lubrication Service with Hand Barrow**

Novel method of handling this service in the plant of the International Harvester Co. brings about a big saving in maintenance. *Belting,* Apr. 1926, pp. 32, 34. Illus. Index no. 658.262.

**Equipment Used for Applying Lubricants**

Frank E. Gooding. Devices used for either continuous or intermittant applying of lubricants to the different designs of bearings used on machines and line shafts. *Industrial Engineer,* May 1926, pp. 213-18, 228. Illus. Index no. 658.262.

**Power Drive Equipment for Industrial Pumps**

Gordon Fox. Discussion of pumps under operating characteristics affecting the selection of the motor, control, and drive connection. *Industrial Engineer,* May 1926, pp. 208-12. Illus. Index no. 658.262.

**Revamping Distribution System**

J. C. Nellegar. Methods used in the H. W. Caldwell and Son Division of Link-Belt Co. to permit a change over from locally generated direct current to purchased alternating current power and light service without stopping production. *Industrial Engineer,* May 1926, pp. 201-7. Illus. Index no. 658.262.

# Marketing and Distribution

## Advertising

**Scientific Advertising**

Harry Dexter Kitson. Codex Book Co., New York. 73 pp. $2. Exploitation of the historical method as a technique for the study of problems in advertising. Results of a six-year study of advertising practice compiled to point out mistakes that have been made and the successful elements which have been adopted. Discusses: Use of historical method in study of advertising problems; history of full page advertisements; heights of headlines; type size ratios; borders; amount and rate of increase in number of illustrated advertisements; development of art forms; color in magazines; pictures of people in magazines; quantitative investigation of pyramiding; position of advertisements on newspaper page; right- and left-hand magazine pages; the package in magazine advertising; negative suggestions; history of the service idea. Index no. 659.1.

**Writing Advertising**

James Davis Woolf. Ronald Press Co., New York. 287 pp. $3.50. This book is the first comprehensive discussion of the methods of creating advertisements presented by an officer of one of our largest advertising agencies. It is significant from several points of view. It is an exposition of the theory of advertising as practiced by a member of a successful organization; it is a body of fundamentals for beginners in the art of advertisement writing; followed through, it becomes a course of systematic instruction in advertisement production. It is, in short, a monograph of an advertising specialist and deserves a prominent place of usefulness in the hands of anyone who has to do with the origination of advertisements and the preparation of the copy. Index no. 659.1.

## Selling

**A Market Survey and Its Results**

H. L. Keely. Describes methods used to market three household products together and the excellent results secured in developing the "trade-marked house." Written from the experience of the Johns-Manville Co. MANUFACTURING INDUSTRIES, June 1926, pp. 421-4. Illus. Index no. 658.83.

**Present Status of Installment Selling**

Early improper methods have created prejudice. System actually a savings device. *Automotive Manufacturer,* Apr. 1926, p. 15. Index no. 658.883.

## Packing, Shipping, Transportation

**Boxes and Cases in the United Kingdom**

A few items on methods in England. *Barrel and Box,* Apr. 1926, p. 41. Index no. 658.78844.

### Effect of Knots on Strength of Bracing

R. P. A. Dixon. Shows the reduction in strength of bracing timber due to knots. Describes numerous experiments and proves that the use of a good cutting steel should always be used to replace a poor one. MANUFACTURING INDUSTRIES, June 1926, p. 440. Illus. Index no. 658.78845

### Railroad Freight Service

Grover G. Huebner and Emory R. Johnson. D. Appleton & Co. New York. 589 pp. $5

Written primarily for the assistance of officials and others in railroad service and for those in charge of traffic and transportation activities of industries. It describes not only organization and operation of the railroad freight service but also those of the traffic departments connected with industries and commercial bodies. The aim has been to present a comprehensive and detailed discussion of the whole field. The author points out that although freight service is necessarily complicated it is becoming increasingly efficient and economical as a result of the splendid constructive work of men of exceptional technical and executive ability. The work of legal, accounting and other departments connected with traffic service is fully described. Classification of freight and the making of rates has been omitted, both because the extent of such material would made an additional volume and because revisions and simplifications are at present in process and will have to be completed before discussion of the subject can be adequately undertaken. Topics covered include: Part I—Railroad Freight Service: Car service; freight cars, their transportation, interchange and demurrage rules and charges; expedited freight services; private cars and lines; special services and privileges—reconsignment or diversion; transit arrangements; special terminal services and privileges—switching, motor truck, etc.; industrial railroads and tap lines. Part II—Freight Traffic Rules and Practices: Bills of lading and other shipping papers; railroad shipping rules; development of freight traffic; routing—its powers and functions; freight claims. Part III—Organization of the Freight Service: Freight traffic department; development of claim department; transportation department; freight stations and transfers; freight traffic associations and classification committees; railroad service association; industrial traffic departments and traffic service organization. Index no. 656.2.

### Wood—The Natural Container for Packing House Products

A. C. Hughes. Status of barrels, specifications adopted by the Chicago Board of Trade. *Barrel and Box*, Apr. 1926, pp. 24-7. Illus. Index no. 658.78845.

# Production Control and Material Handling

## Production Control

### Accuracy Control in Interchangeable Manufacture

Charles O. Herb. How the White Motor Co. specifies limits on parts and gages from standardized lists and systematically inspects all gages. *Machinery*, May 1926, pp. 683-6. Illus. Index no. 658.562.

### Control of Inventory Through the Scientific Determination of Lot Sizes—VII

H. S. Owen. Perpetual inventory stock records. *Industrial Management*, Apr. 1926, pp. 257-60. Illus. Index no. 658.787.

### Division of Labor in Tool Manufacture

G. A. Pennock. The way in which specialization and standardization are practiced in tool making at the Hawthorne Works of the Western Electric Co. *American Machinist*, Apr. 15, 1926, pp. 599-600. Index no. 658.542

### Keeping Up Improved Operating Results

Jos. A. Piacitelli. A management problem of major importance is to make improvements and betterments permanent so that the advantages once secured can be maintained indefinitely. This article shows how such improvements have been made permanent in one of the plants of the Barber Asphalt Company. MANUFACTURING INDUSTRIES, June 1926, pp. 435-9. Illus. Index no. 658.542.

### Knitting Plant Material Control

Herbert C. Gates. One of the most difficult control problems is found in knitting mills because of the great variety of material, color, style and finish of knitted garments. This article shows in detail how a system has been developed for material control and has proved satisfactory in use. MANUFACTURING INDUSTRIES, June 1926, pp. 445-7. Illus. Index no. 658.78.

### Maker and User Profit by New Methods

E. M. Olin, works manager, describes the new layout of sad iron assembly and the mechanical handling equipment installed to increase production and reduce costs in the Westinghouse Electric and Mfg. Co., Manfield, Ohio, plant. Equipment will pay for itself in two years and has permitted a reduction of $1 in retail selling price of automatic irons. MANUFACTURING INDUSTRIES June 1926, pp. 413-16. Illus. Index no. 658.5

### Measuring by Optical Means

Applications of two instruments developed by the Bausch & Lomb Optical Co. for use in shop, toolroom, and inspection department. *Machinery*, May 1926, pp. 695-7. Illus. Index no. 658.562.

### Selecting the Proper Steel for Making Shop Tools

J. B. Mudge. Classification system, testing methods, and results worked out by the Hawthorne Works of the Western Electric Co. *Iron Trade Review*, Apr. 29, 1926, pp. 11-16, 18. Illus. Index no. 658.562

### Standards of Performance in Shop Work

J. Seton Gray. Time study method, different kinds of standards, and how standards aid efficiency studies and estimating even without premium or bonus plans. *Machinery*, May 1926, pp. 724-5. Index no. 658.542.

## Production Processes

### Bar Work

M. E. Lange. Book one, of a series on modern tooling methods for turret lathes, intended to increase production on the large number of such machines now in operation. Fully illustrated with photographs and diagrams of work. Methods of doing a wide variety of jobs are completely outlined. Warner and Swasey Co. Pamphlet. 47 pp. Index no. 658.561.

### Chuck Work—I

M. E. Lange. Book two, of a series on modern tooling methods for turret lathes. Problems of work; choice of machine; holding devices; order of operations; typical chucking set-ups. Warner & Swasey Co. Pamphlet. 31 pp. Index no. 658.561.

## Material Handling

### Control Equipment for Industrial Trucks

R. B. Hunter. Controller apparatus and its installation on small battery-propelled trucks and industrial locomotives, with graphs and diagrams to aid in selecting the type best suited to the operating conditions. *Industrial Engineer*, May 1926, pp. 219-24. Illus. Index no. 658.281.

### Essentials of Industrial Truck and Tractor Lubrication—II

Allen F. Brewer. Lubrication of gear and chassis parts on gasoline and electrical industrial truck equipment. *Industrial Management*, Apr. 1926, pp. 247-52. Illus. Index no. 658.281.

### Modern Methods Applied to Three Plants One of Which Excels in Design

F. A. Westbrook. Producing methods and material handling equipment of the New York Trap Rock Corp. Flow sheet of operations, producing methods and material handling equipment. *Pit and Quarry*, Apr. 15, 1926, pp. 51-66. Illus. Index no. 658.281.

### What Executives Can Learn from the Automotive Industry—III

Jervis B. Webb. Descriptive outline of application of conveyors to production. *Industrial Management*, Apr. 1926, pp. 230-4. Illus. Index no. 658.281.

# Employment and Personnel Management

## Selection and Training

### Apprenticeship Principles

Definitions, form of agreement, requirements and obligations of apprenticeship as finally adopted by the New England Foundrymen's Association. New England Foundrymen's Association. Pamphlet. 10 pp. Index no. 658.3801

### Has the Need for Apprenticeship Passed?

W. A. Viall. Details of the experience of and methods used in apprenticeship at the Brown & Sharpe Mfg. Co. *Mechanical Engineering*, May 1926, pp. 409-11. Index no. 658.3801

### The Training of Future Executives

John Younger. Manufacturing requirements

call for thorough preliminary training, either through apprenticeship or in colleges, followed by practical experience in the plant. *Society of Automotive Engineers Journal,* May 1926, pp. 479-81. Index no. 658.386.

### Remuneration

**High Productivity Necessitates High Wages**

James Maloney. Modern methods and mechanization of manufacturing have increased production greatly and the workers co-operation deserves higher remuneration. *American Federationist,* May 1926, pp. 570-4. Index no. 658.321.

**Real Relation of Wages and Living Cost**

L. M. Stowell. MANUFACTURING INDUSTRIES, June 1926, p. 448. Illus. Index no. 658.3831.

### Health and Safety

**Physical Examinations in Industry**

Frank L. Rector. Outline of the status of medical examinations in American industry with a list of representative firms in which the practice is fully established. *Monthly Labor Review,* Apr. 1926, pp. 18-23. Index no. 658.38222.

**Safety in Materials Handling**

David S. Beyer. The author estimates that the yearly economic loss due to materials handling accidents is $250,000,000. He emphasizes the necessity of considering accident hazards in developing construction drawings and specifications. *Mechanical Engineering,* May 1926, pp. 475-80. Illus. Index no. 658.3823.

**Saving the Eyes of the Worker**

Sanford DeHart. A review of results of 10 years of industrial eye work on 15,000 injuries. *Industrial Management,* Apr. 1926, pp. 253-6. Illus. Index no. 658.3822.

## Financial Control and Accounting

### Financial Control

**Budget Plan of Liquid Carbonic Company**

Willard J. Graham. Detailed presentation of the methods used in developing sales, manufacturing and financial budgets of a manufacturing concern doing an annual business of about $8,000,000. Results of the system, which has been in use about two years, are qualitatively given. MANUFACTURING INDUSTRIES, June 1926, pp. 425-30. Illus. Index no. 658.14.

**Essentials of Budgeting Technique**

Chester P. Grassmuck. *The Management Review,* May 1926, pp. 131-60. Index no. 658.14.

**Operating and Turnover Ratios**

Arthur Andersen. This is the seventh article in Mr. Andersen's series showing how to organize, conduct and use a financial and industrial investigation as a management procedure. MANUFACTURING INDUSTRIES, June 1926, pp. 441-4. Index no. 658.14.

### Accounting and Cost Finding

**Cost Accounting for Sales**

Joseph Robert Hilgert. Ronald Press Co. New York. 259 pp. $4.50. A discussion of the principles underlying analyses and control of sales-cost accounts, whether manufacturers or wholesale distributors. The underlying purpose has been to show the relationship between sales management and accounts; to indicate how sales-cost accounts may be used to construct reports of practical value to the sales manager and general manager; to show how these executives may interpret the reports and establish progressive sales policies. The discussion begins with the marketing organization and its problems, presents the principles of budgetary control, shows how to organize the field force, and then takes up in detail various important items of accounting for the sales department and all of its subdivisions and branches. Index no. 657.444.

**Detailed Costs in the Machine Shop**

James A. Thomas. Starting or remodeling a cost system to get costs of details. *Machinery,* May 1926, pp. 710-11. Index no. 657.452.

**Overhead in Economics and Accounting**

T. H. Sanders. *National Association of Cost Accountants' Bulletin,* Apr. 15, 1926, pp. 583-91. Index no. 657.441.

## Miscellaneous

**American Labour Movement and Scientific Management**

Paul Devinat. *International Labour Review,* Apr. 1926, pp. 461-88. Index no. 331.

**Cotton Facts (1925 Ed.)**

Shepperson Publishing Co. New York. 167 pp. $1.50. Yearbook containing comprehensive data from official sources upon foreign and domestic cotton. Covers many topics connected with culture, yield, ginning, movement, receipts, imports and exports, stocks, prices, consumption, spindles and manufactures. This issue completes the fiftieth year of publication. It contains several new features: Cotton and cloth exports, imports, manufactures and production; cottonseed section; review of cotton growing in Africa, Russia, China and Japan; Rayon production by countries; etc. Data compiled particularly for the purpose of making future estimates based on comparative record of past experiences. Index no. 338.1.

**Creative Chemistry**

Edwin E. Slosson. Century Co., New York. 311 pp. $1. A masterpiece of exposition, prepared for the reader unfamiliar with technical terms, and showing the tremendous importance of the chemical industry in modern times. The three periods of progress—appropriative, adaptive and creative—are outlined. Following this a number of fields in which chemistry has revolutionized manufacturing and modern life are discussed. These cover the application of nitrogen; feeding the soil; coal tar colors; synthetic perfumes and flavors; cellulose; synthetic plastics; the race for rubber; the rival sugars; what comes from corn; solidified sunshine; fighting with fumes; products of the electric furnace; metals, old and new. The book also has an extensive list of worth while reading references on the various subjects discussed in its chapters. Index no. 660.

**Decisions of Courts Affecting Labor—1923-1924**

Lindley D. Clark and Stanley J. Tracy. Bulletin of the U. S. Bureau of Labor Statistics, No. 391. 551 pp. $0.70. Index no. 331.

**New Era for American Workers**

James J. Davis. Description of immigration and its vital effects upon American industrial civilization. *Industrial Management,* pp. 218-20. Index no. 325.

**New and Advanced Position of Organized Labor**

William Green. Response to problems of management and co-operation in the elimination of waste. *Industrial Management,* pp. 221-4. Index no. 331.

**Pit and Quarry Handbook for 1926**

Edited by H. W. Munday. Complete Service Publishing Co., Chicago. 576 pp. $5. Fourth annual edition of the handbook of useful and practical information for the sand, gravel, stone, cement, gypsum and lime industries. It is the combined work of more than a dozen specialists co-operating with H. W. Munday as editor. The information is divided into 30 sections and covers the basic technical processes and equipment used in the non-metallic mineral industries. Its value is emphasized by the fact that it is the only reference handbook published for this particular group of manufacturers. Index no. 622.2.

**Retail Prices—1890-1924**

Food, coal, gas, and electricity; purchasing power of union wages, as measured in food. Bulletin No. 396 of U. S. Bureau of Labor Statistics. 237 pp. $0.30. Index no. 338.5.

**Trade Agreements—1923-1924**

Compiled by Edson L. Whitney. Covers many manufacturing, building, and transportation trades. Bulletin No. 393 of the U. S. Bureau of Labor Statistics, 128 pp. $0.15. Index no. 331.157.

**Women in Illinois Industries**

Study of hours and working conditions. U. S. Dept. of Labor, Bulletin of the Women's Bureau, No. 51. 108 pp. Index no. 331.4.

# New Industrial Equipment

### Elevating Platform Truck

Made by the Yale and Towne Manufacturing Co. and designated as Yale K23-E. Designed primarily for extremely heavy loads and [illegible]. Has short turning radius and narrow width. Large front and rear tires effectively support load, and, together with high-pressure lubricating system and hardened steel steering pivots and bronze bushings, make steering easy. Elevates loads to a moderate height at rapid speed. Upper and lower limit stops assure safety.

Heavy frame members and large elevating links give high factor of safety. Power drive designed for efficient lubrication and minimum friction. Controller is a sub-assembly and, together with other units and sub-assemblies, is standard and interchangeable with all other models of the K series, to ensure economy in maintenance and repair work. Index no. 658.281.

### Motor Trolley for Hoists

Made by the American Engineering Company for use with its ½ ton and 1 ton, Class A "Lo-Hed" electric hoists, heretofore built in bolt suspension and plain trolley types only. Trolley supplied with travel speeds of 80 or 120 ft. per min. Accurate control makes spotting of work convenient. Arranged for either direct or remote control. Drives on all four wheels. Requires only 22 in. head room.

Ruggedly built, the three main castings being of cast steel. Hyatt roller bearings used on all shafts; ball bearings in the motor. Thoroughly lubricated. Furnished for d. c. or a. c. 2- or 3-phase current. Can be used to convert any "Lo-Hed" hoist now in service into a motor trolley hoist. Index no. 658.281.

### Pneumatic Sweeper System

Electrically operated equipment for removing, conveying, and collecting dust in one operation. Designed to work without raising any dust and hence particularly suitable for use in textile, lead, wall paper, silk, starch, and hard rubber industries, in coal pulverizing plants, grain elevators, to remove dust from the tops of boilers and other equipment in central stations, etc.

Multi-stage centrifugal blowers and exhausters driven by Westinghouse motors, and built in units of ½ to 50 hp., handle the dust, and are suitable for delivering air or gas over a great range of volumes and at different pressures. Minimizes dust explosion hazards. Manufactured by the Allen & Billmyre Co. Inc. Index no. 621.55.

### Portable Electric Die Stock

Developed by the Oster Manufacturing Co. for threading ⅜, ½, and ¾ in. pipe. Die head is actuated by an enclosed universal motor operating from any lamp socket on 110 volts d. c. current or a. c. current in any cycle from 25 to 60. Operated by placing it on the end of a stationary length of pipe and centering by means of a universal chuck, which eliminates loose parts and also the necessity for filing off the burr.

Die heads changed by disengaging the head from the sleeve by means of a pawl. Successive quarter turns of operating switch rotate the die, stop the motor, reverse the die, and stop the motor. Cuts standard, oversize or under-size threads. Total weight 35 lbs. Index no. 621.944.

### Portable Universal Saw

Operates saw for [illegible] all advantages of portable bench machine and self-contained floor type. Motor and all working parts are built into the upper portion, which can be lifted off the regular stand and taken to any point where work is to be done. Motor is 1 hp. 3-phase, constant-speed, air-cooled, and is directly geared to saw spindle. Table is 25 by 25 in. and is fitted with a removable throat piece to accomdate saws requiring a wider throat opening.

Handles work up to 2¼ in. thick, and, with adjustments, will cut compound mitres, grooves ⅞ by 1 in., moldings, angles, etc. When cutting angles the saw is tilted instead of the table—a time-saving and safety feature. Equipped with ripping fences, cross cut fences, and complete guards. Mounted on one-way castors for rigidity in operation. Made by J. D. Wallace & Co. Index no. 621.723.

### Shovel-Type Transformers

Used on electrically operated shovels where vibration and shock are prevalent and where the transformer is inclined at various angles, causing leakage of oil and consequent overheating in ordinary pole-type distribution transformers. Also applicable in cement and flour mills, and mine service and subway installations, where dust would clog the ventilating ducts, contaminate oil and cause overheating of ordinary types.

Made at present in 2300-volt single phase, 60-cycle size. Other voltages are also obtainable. Made with heavy end-frame construction, oil-tight welded sheet metal tank, oil-tight bushings, and additional bracing to prevent transformer from sliding around inside of tank. Made by Westinghouse Electric and Mfg. Co. Index no. 621.3143.

### Steel-Bound Platforms

Steubing-Cowan Company have secured patents and commenced manufacture of an extra-strong lift-truck platform suitable for all kinds of industrial use. Made in the following types: Sectional bin, crane lift, standard base, spindle rack, core rack, stake, cradle rack, and slat bin. Steel bound full length and specially clamped to prevent sagging. Made of heavy oak planking, held in steel side rails by forged steel bolts and supported on forged steel legs with broad smooth surface to prevent damage to floors. Oak top provides long service and safe handling of materials whether fragile or heavy.

Standard platforms made in Type S, 3500-lb. capacity, with tops ranging from 24 by 28 in., ⅞ in. thick, to 36 by 36 in., 1⅛ in. thick; Type S, 4000-lb. capacity, with tops 33 or 36 by 42 in., 1⅛ in. thick; Type M, 5000-lb. capacity, with tops ranging from 33 by 48 by 1⅛ in. thick, to 48 by 72 by 1⅜ in. thick. Other sizes made on special order. Legs 6½, 7½, 9½ or 11½ in. high. Index no. 658.281.

### Synchronous Motors

The General Electric Co. offers a new line of synchronous motors of the G. E. types TS and QA and known as the 7500 series, for general purpose application. They will drive any load whose torque requirements have been heretofore met with a standard squirrel cage induction motor. Ratings range from 20 to 150 hp. with speeds of 1200, 900, 720 and 600 r. p. m. at 60 cycles. The motors, with minor changes, will operate at unity, 90 or 80 per cent power factor, and are rated at 40 deg. continuous temperature at unity power factor. At 90 or 80 per cent power factor the temperature of the stator will not exceed 40 deg., with 50 deg. on the rotor.

Each motor is guaranteed to deliver the same starting torque with the same inrush current as the standard squirrel cage induction motor of similar rating. At full line voltage the motor will accelerate and synchronize a load whose torque is 100 per cent of the rated full load torque of the motor.

Motors are of the revolving field, salient pole type and are separately excited. Semi-automatic control is recommended, by means of which the field excitation is automatically applied. Operations required to start are identical with the starting of a squirrel cage induction motor. Index no. 621.31344.

### Synchronous Motor Controls

Automatic starter, self-contained and oil immersed, for 2300-volt synchronous motors. Built for across-the-line starting of slow speed motors and for reduced voltage starting of higher speed motors. Operator merely pushes a button to start the motor and as it approaches synchronous speed the field excitation is automatically applied.

The reduced voltage starter consists of a welded tank containing automatic double-throw switching mechanism, power transformer for starting voltage, potential transformer for 220-volt master-switch operating current, and current-limit transition relay connecting motor to full voltage when it reaches 85 per cent of synchronous speed. A separate dustproof steel cabinet encloses the field switching mechanism, field discharge resistor, timing relay, and d. c. field ammeter. It may also contain an automatic starter for operating a magnetic clutch. The full voltage starter is similar except for omission of starting auto-transformers.

Single unit construction makes floor mounting possible. Manufactured by the Electric Controller and Manufacturing Co. Index no. 621.31723.

### Welding Torch

A sturdy, compact torch, smaller than standard size, but designed for a high degree of efficiency. Uses same tips as standard torches and is adaptable to all classes of welding. Light in weight, rapid in operation and economical in use of oxygen and acetylene which it uses at low and comparatively equal pressures, from either generators or tanks.

Standardized system of multiple mixing gives a uniform flame. Special construction of seating surfaces between tips and head allows lateral expansion without distortion and permits easy refacing. Made of bronze forgings and specially-drawn stainless tubing. Head set at an angle of 67½ deg. to allow natural operating position, utilize heat to best advantage, and protect operator's hands. Equally balanced for easy manipulation. Length 18 in., weight 25 oz. Furnished with three welding tips. Trade designation, Type J-Jr. Made by Alexander Milburn Co. Index no. 621.7923.

# News of Manufacturing Industries

## The Month in Brief

**Aluminum Company of America** has acquired controlling interest in Duke-Price Power Company, Ltd.

**Amerada Corporation** has acquired 5600 acres of developed and undeveloped territory in Coleman and Callahan Counties, Texas. Other recent purchases are 960 acres in the Panhandle field at Texas and 1000 acres of scattered leaseholds in the Seminole fields of Oklahoma.

**American Electric Corporation.**—An initial quarterly dividend of 1¾ per cent on Class A cumulative convertible stock was declared payable May 15.

**American Brown Boveri Electric Corporation** has launched the first completely electrically equipped dipper dredge and the most powerful craft of its kind in the world. It is driven by Diesel engine units.

**American Engineering Company** announces the appointment of H. Kemper as sales manager of its "Lo-Hed" electric hoist division.

**American Hide & Leather Company.—**

| Quarters Ending, Mar. 31 | 1926 | 1925 | 1924 |
|---|---|---|---|
| Net earnings (see note) . . | $56,141 | $201,235 | $261,719 |
| Depreciation | 54,673 | 62,482 | 61,130 |
| Balance | $1,468 | $253,654 | $200,589 |

Note.—Results from operations after charging repairs, interest on loans, and reserves for taxes

**American La France Fire Engine Company, Inc.—**

| Quarters ending Mar. 31 | 1926 | 1925 |
|---|---|---|
| Operating profit | $195,553 | $201,235 |
| Interest and taxes | Cr.7,739 | 42,908 |
| Net income | $203,291 | $158,327 |
| Premium on sales of stock | 186,737 | |
| Partial refund of taxes | 289,849 | |
| Total net income | $679,877 | $158,327 |

**American Locomotive Company.**—The stockholders have approved the merger of the American Locomotive Company and the Railway Steel Spring Company. The capital of the merged companies will be 385,000 shares of $100 par preferred stock and 770,000 shares no par common stock.

**American Non-Gran Bronze Corporation.**—This company was incorporated in 1925 to take over the plant of the American Bronze Corporation, sold under sheriff's sale. The president is Philip E. Guckes. The new company will continue manufacture of non-gran bearing metal and bars, castings and bushings of bronze.

**Art Metal Construction Company.—**

| Quarter ended March 31 | 1926 | 1925 |
|---|---|---|
| Shipments | $2,084,484 | $1,567,045 |
| Cost of goods shipped | 1,804,504 | 1,394,167 |
| Estimated taxes | 38,000 | 21,000 |
| Dividends | 80,143 | 80,143 |
| Available for surplus | $161,838 | $71,735 |

**Atlas Tack Corporation.—**

| Quarters ended March 31 | 1926 | 1925 |
|---|---|---|
| Net income after charges but before taxes | $21,567 | $43,805 |

**Berkey & Gay.**—Three of the foremost manufacturers of house furnishings have consolidated, retaining a part of the name of one of the companies. These companies are: Berkey & Gay Furniture Company, Wallace Furniture Company and the Grand Rapids Upholstering Company.

**Sydney Blumenthal & Company.—**

| Three months ended March 31 | 1926 | 1925 |
|---|---|---|
| Earnings from operation | $192,764 | $125,408 |
| Accrued interest | 32,961 | 34,693 |
| Depreciation reserve | 60,821 | 69,880 |
| Inventory loss | ..... | 56,148 |
| Loss on mill operation | 122,464 | 182,821 |
| Net loss | $23,482 | $218,134 |
| Preferred dividends paid from surplus | | 41,877 |

**Bridgeport, Connecticut,** outranks all other cities in the state in wages paid, value of products and number of wage earners, as shown by the census statistics for the year 1923. The number of wage earners was 33,207; wages paid were $37,882,000; value of products produced was $148,856,000.

**Brideport Brass Company.**—Charles H. Clark has recently joined the organization as raw material salesman for the state of Massachusetts and the cities of Providence, R. I., and Meriden, Conn.

**Brill Corporation.**—The directors have declared an initial dividend at the rate of 7 per cent per annum on the preferred stock, for the two months period beginning Feb. 1 and ending March 31, 1926, payable June 1.

**Botany Consolidated Mills, Inc.**—The following have been elected officers of the company: President, Max W. Stoehr; vice presidents, Col. C. F. H. Johnson, Ferdinand Kuhn, Dr. W. L. Wirbelauer, F. Haltmayer and Walter Koch; secretary and treasurer, and general counsel, Harold G. Aron.

**Botany Worsted Mills.**—At a meeting of the stockholders held April 29 the following officers were elected: Chairman of board of directors and treasurer, Max W. Stoehr; president, Ferdinand Kuhn; vice-presidents, Col. C. F. H. Johnson, H. V. R. Scheel and C. H. Schlachter; vice-president and assistant treasurer, F. Haltmayer, and secretary, A. de Liagre.

**Brown and Williamson Tobacco Company.**—It is reported that this company has purchased the plant and business of the Richardson Tobacco Company at Reidsville, N. C.

**Canada Dry Ginger Ale, Inc.—**

| Quarters ending March 31 | 1926 | 1925 |
|---|---|---|
| Sales, in bottles | 13,500,050 | 8,024,900 |
| Net earnings, after advertising, depreciation, and all other charges including taxes | $349,297 | $176,356 |

**Casein Company of America.**—Directors declared a regular quarterly dividend of 2 per cent on preferred stock and an extra dividend of 1 per cent, both payable May 12.

**Champion Fibre Company** is offering $2,000,000 15-year sinking fund 6 per cent gold notes.

**Chrysler Motor Corporation.**—A net income of $4,112,089 after charges, but before Federal taxes, is shown in the statement for the initial quarter of this year of the Chrysler Motor Corporation. After dividend requirements on the Class A preferred this is equal to $1.35 a share earned on 2,711,640 shares of no par common stock. In the corresponding period of last year the income was $3,501,226, or $1.13 a share.

**Columbian Carbon Company.**—The company has recently purchased all the acreage of the Texas Company in the Monroe gas field, Louisiana, comprising about 20,000 acres, with 25 producing gas wells having a total open flow capacity of 200,000,000 cubic feet a day. The consideration was reported to be approximately $1,800,000. The Columbian Carbon Company already held 40,000 acres and a capacity of well over 1,000,000,000 cubic feet a day. A good part of the newly acquired acreage is virgin territory which has never been drawn upon, and several of the wells still retain their original rock pressure of 1000 pounds per square inch.

**Diamond Match Company.—**

| Income account for quarter ended March 31, 1926 | |
|---|---|
| Operating income | $785,636 |
| Depreciation and amortization | 155,082 |
| Federal, state and county taxes | 214,914 |
| Net profit | $415,640 |
| Dividends | 336,000 |
| Surplus | $79,640 |
| Profit and loss surplus | $4,726,503 |

**Donovan Lumber & Affiliated Companies** has just put into effect a group plan insurance for its employees. The number of lives covered is 479 and the amount of the policy $478,400. This insurance is granted without cost to the workers.

**E. I. DuPont de Nemours Powder Company.**—This company, which has been inactive since its business was acquired by the E. I. DuPont de Nemours Company

*(Continued on page 462)*

# Manufacturing Industries

## Cumulative Index to Vol. XI

JANUARY-JUNE 1926


A

Accidents, Elimination of (See Safety)
Accounting (See Auditing; Cost Accounting)
Accounts for Values on Drawings. Dillman. Feb., 118
**Air Brake Industry**
Labor-Saving Equipment Features New Westinghouse Air Brake Plant. Wildin. May, 337-42
Air Economizers. Industrial Equipment. Mar., 217
**Aldrich, John G.**
Short Cuts to Accurate Order-Filling. May, 335-6
Assignment Charts as Management Tools. Reuter. May, 367-8
Analysis of Net Worth in the Financial and Industrial Investigation. Andersen. Mar., 201-6
**Andersen, Arthur**
The Financial and Industrial Investigation: Scope, Jan., 17-22; Organization and Personnel, Feb., 113-17; Net Worth, Mar., 201-6; Operating Statements, Apr., 277-80; Balance Sheet Ratios, May 351-4; Turnover Ratios, June, 441-4
**Ash Handling**
Coal and Ash Handling at Quarter the cost. Feb., 106
**Ashworth, Harold**
The Modern Manufacturing Plant. Atwater Kent Co. Jan., 7-10
**Automobile Industry**
Buick Saves $3,500,000 in Nine Months. Clark. Feb., 85-8
Cadillac Keeps Strict Watch on Quality. Fisher. June, 409-12
General Motors Purchasing Power Index. Weaver. Apr., 291-2
Keeping Research on a Business Basis. Hagemann. May, 359-62
Maintaining Hourly Control of Production. Brooke. Apr., 271-4
Market Analysis Checks Over-Production. Willys. Apr., 165-8
Patent Pooling Develops Auto Industry. Bauer. Mar., 207-9
Relation of Safety and Production. Luckenbach. Jan., 25-8
Testing Products from the User's Angle (General Motors proving ground). Hagemann. June, 431-4

B

Baffle Wall for Boilers. Industrial Equipment. Mar., 217
**Balance Sheet Analysis**
Operating and Balance Sheet Ratios. Andersen. May, 351-4
**Barber, Joseph H.**
Forecasting Volume of Coming Orders. Apr., 253-6
A Timely Guide to Manufacturing Control. June, 417-20
Barth Standard Wage Scale. May, 373-4
**Bauer, George F.**
Patent Pooling Develops Auto Industry. Mar., 207-9
**Bearings**
Line Shaft Bearings. Industrial Equipment. May, 379
Bending Roll. Industrial Equipment. Mar., 217
**Blowers**
Blast Furnace Blowers. (Industrial Equipment). Apr., 297
**Boilers** (See also Ash Handling; Coal Handling)
Coal Handling and Boiler Operation at Northern Paper Mills. Gochnauer. Jan., 23-4
**Bonus** (See Wage Payment)
Break-even-point (The) Chart a Management Tool. Reuter. Apr., 290
**Brooke, George G.**
Maintaining Hourly Control of Production. Apr., 271-5
**Budgeting**
Budget Plan of Liquid Carbonic Company. Graham. June, 425-30
Budgeting the Textile Industry. Tharp. Jan., 29-34
Major Results of Budgetary Control. Clithero. May, 343-6
Novel Budgets Cut indirect Expenses. Harmon. Mar., 189-92
Successful Budgetary Control in Fine-Paper Mills. Grasselt. Apr., 257-60
Successful Budget Installation. Tharp. Feb., 89-92
Buick Saves $3,500,000 in Nine Months. Clark. Feb., 85-8
**Building Materials Industry**
Cutting Labor Costs 37 Per Cent. Underwood. Feb., 119-24
The First Step in a Market Survey. Keely. May, 355-8
Keeping Up Improved Operating Results. Piacitelli. June, 435-9
A Market Survey and Its Results. Keely. June, 421-4
Reducing Costs 22% by Motion Study. Piacitelli. Apr., 281-6; May, 347-50
**Buildings and Equipment** (See also Lighting)
Atwater Kent Company Has World's Largest Radio Factory. Ashworth. Jan., 7-10
Labor-Saving Equipment Features New Westinghouse Air Brake Plant. Wildin. May, 337-42
Modern Design Features New Planer Plant. Cardullo. Apr., 261-5
Peerless Portland Cement Pioneers in Plant Design and Layout. Gillespie. Mar., 195-200
Scientific Planning for the New Western Electric Plant. Spurling. Feb., 101-6

C

Cadillac Keeps Strict Watch on Quality. Fisher. June, 409-12
**Car Loading** (See also Freight Cars)
Cutting Labor Costs 37 Per Cent. Underwood. Feb., 119-24
**Carbonic Industry**
Budget Plan of Liquid Carbonic Company. Graham. June, 425-30
**Cardullo, Forrest E.**
Modern Design Features New Planer Plant. Apr., 261-5
**Cement Industry**
Peerless Portland Cement Pioneers in Plant Design and Layout. Gillespie. Mar., 195-200
**Charts** (See Graphic Charts)
**Chemical Industry**
Handling Products in the Squibb Plant. Hagemann. Jan., 35-8
How the Bakelite Corporation Effectively Manages Organized Research. Mory and Quigley. Jan., 13-16
**Churchill, W. L.**
Pricing for Profit vs. Pricing for Volume. Apr., 267-70
Unfair Selling Prices. Feb., 97-100
What Should the Net Profit Be? Mar., 175-8
**Clark, W. W., Jr.**
Buick Saves $3,500,000 in Nine Months. Feb., 85-8
**Clithero, W. S.**
Major Results of Budgetary Control. May, 343-6
**Coal Handling**
Coal and Ash Handling at Quarter the Cost. Feb., 106
Coal Handling and Boiler Operation at Northern Paper Mills. Gochnauer. Jan., 23-4
Computing Relative Speeds of Work to Save Time Study Expense. Mawson. May, 371-2
**Condensers**
Steam Condensers for Motors. Industrial Equipment. May, 379
**Containers** (See Shipping Containers)
**Conveyors** (See Material Handling)
**Conway, J. B.**
Getting the Right "Slant" from Charts. Apr., 266
**Cost Accounting** (See also Power Plant Operation)
A Neglected Phase of Cost Accounting. Robinson. Jan., 41
Summarizing Costs for the Directors. Rosenthal. Mar., 179-84
Cost of a Steam-Operated Power Plant. Sheridan. Mar., 193-4
**Coupling**
Flexible Coupling. (Industrial Equipment). Jan., 60
**Cox, Jacob D., Jr.**
What Determines Wages in Industry? Apr., 245-8
Cutting Labor Costs 37 Per Cent. Underwood. Feb., 119-24

D

**Die Stock**
Electric Die Stock. (Industrial Equipment). June, 455
**Dillman, Joseph F.**
Accounting for Values in Drawings. Feb., 118

**Dispensaries**
Keeping Down the Cost of the Factory Dispensary. Rossy. Jan., 55
DOUBLE (A) PURPOSE PLATFORM FOR HANDLING MATERIAL. Apr., 286

E

**Economizers**
Lead-coated Economizers. (Industrial Equipment). May, 379
**Edge, H. H.**
Simplified Production and Handling. Kelly Press Plant. Feb., 93-6; Mar., 185-8
**Edwards, H. G.**
A Fence Made from Scrap. Jan., 50
EFFECT OF KNOTS ON STRENGTH OF BRACING FOR CARLOAD FREIGHT. Johnson. June, 440
EFFECTIVE (AN) PRODUCTION CONTROL SYSTEM. Swan. Jan., 39-43
**Electrical Industry**
Maker and User Profit by New Methods. Olin. June, 413-16
EMPLOYEE TRAFFIC RULES. May, 346

F

**Fatigue**
Fatigue from a New Point of View. Haggard. May, 363-6
FENCE (A) MADE FROM SCRAP. Edwards. Jan., 50
$52,000 SAVED IN NON-PRODUCTIVE WORK. Heimstreet. June, 449-50
**Financial and Industrial Investigation** (See Andersen, Arthur)
FINDING CAUSES OF QUALITY VARIATIONS. Shewhart. Feb., 125-8
FIRST (THE) STEP IN A MARKET SURVEY. Keely. May, 355-8
FIRST (THE) STEP IN MANUFACTURING. Apr., 256
**Fish, E. H.**
Reorganizing a Rundown Manufacturing Plant. Apr., 275-6
**Fisher, Lawrence P.**
Cadillac Keeps Strict Watch on Quality. Fisher. June, 409-12
**Forecasting**
Foreseeing Volume of Coming Orders. Barber. Apr., 253-6
A Timely Guide to Manufacturing Control. Barber. June, 417-20
FORESEEING VOLUME OF COMING ORDERS. Barber. Apr., 253-6
**Freight Cars** (See also Car Loading)
Effect of Knots on Strength of Bracing for Carload Freight. Johnson. June, 440
"Please Clean This Car." Jan., 28

G

**Gates, Herbert C.**
Knitting Plant Material Control. June, 445-7
GENERAL ELECTRIC GROUP INSURANCE. Jan., 12
GENERAL MOTORS PURCHASING POWER INDEX. Weaver. Apr., 291-2
GETTING THE RIGHT "SLANT" FROM CHARTS. Conway. Apr., 266
**Gillespie, John**
Peerless Portland Cement Pioneers in Plant Design and Lay-out. Mar., 195-200
**Gochnauer, H. W.**
Coal Handling and Boiler Operation at Northern Paper Mills. Jan., 23-4
**Graham, Willard J.**
Budget Plan of Liquid Carbonic Company. June, 425-30
**Graphic Charts**
Alignment Charts as Management Tools. Reuter. May, 367-8
The Break-even-point Chart a Management Tool. Reuter. Apr., 290
Getting the Right "Slant" from Charts. Conway. Apr., 266
**Grasselt, H. M.**
Successful Budgetary Control of Production in Fine-Paper Mills. Apr., 257-60
**Group Insurance**
General Electric Group Insurance. Jan., 12
**Guide to Latest Information**
Jan., 56-60; Feb., 131-5; Mar., 213-17; Apr., 293-7; May, 375-9;

H

**Hagemann, George E.**
Handling Products in the Squibb Plant. Jan., 35-8
Keeping Research on a Business Basis. May, 359-62
Testing Products from the User's Angle. (General Motors proving ground). June, 431-4
**Haggard, Howard**
Fatigue from a New Point of View. May, 363-6
HAND LABOR AND MACHINERY AS PRODUCERS. Polleys. Jan., 11-12
HANDLING PRODUCTS IN THE SQUIBB PLANT. Hagemann. Jan., 35-8
**Harmon, U. L.**
Novel Budgets Cut Indirect Expenses. Mar., 189-92
What Management Has Done for Us. Jan., 51-4
**Heimstreet, V. V.**
$52,000 Saved in Non-Productive Work. June, 449-50
**Hoists**
Ball-bearing Electric Chain Hoist. (Industrial Equipment). Apr., 297
Gasoline Hoists. (Industrial Equipment). Jan., 60
Hoisting Apparatus for Buildings. June, 430
Motor Trolley for Hoists. (Industrial Equipment). June, 455
HOW THE BAKELITE CORPORATION EFFECTIVELY MANAGES ORGANIZED RESEARCH. Mory and Quigley. Jan., 13-16

I

IMPROVED METHODS DOUBLE PRODUCTION. O'Connor. May, 369-71
**Index to Current Management Literature** (See Guide to Latest Information)
**Indicating and Recording Instruments**
Motor-driven $CO_2$ Recorder. (Industrial Equipment). May, 379
INDUSTRIAL AND PUBLIC UTILITY PROFITS IN 1925. Apr., 260
**Industrial Equipment** (See also device in question)
Jan., 60; Mar., 217; Apr., 297; May, 378-9; June, 455
**Inspection**
Cadillac Keeps Strict Watch on Quality. Fisher. June 409-12
Finding Causes of Quality Variations. Shewhart. Feb., 125-8

J

**Jack**
Self-lowering, Governor-controlled Jack. (Industrial Equipment). May, 379
**Johnson, R. P.**
Effect of Knots on Strength of Bracing for Carload Freight. June, 440
JUDGING OPERATING RESULTS. Andersen. Apr., 277-80
JUDGING ORGANIZATION AND PERSONNEL. Andersen. Feb., 113-17

K

KEEPING UP IMPROVED OPERATING RESULTS. Piacitelli. June, 435-9
KEEPING DOWN THE COST OF THE FACTORY DISPENSARY. Rossy. Jan., 55
KEEPING RESEARCH ON A BUSINESS BASIS. Hagemann. May, 359-62
**Keely, H. L.**
The First Step in a Market Survey. May, 355-8
A Market Survey and Its Results. June, 421-4
**Kilns**
Management in Lumber Dry Kilns. Perry. Jan., 45-50
KNITTING PLANT MATERIAL CONTROL. Gates. June, 445-7

L

**Labor Efficiency**
Cutting Labor Costs 37 Per Cent. Underwood. Feb., 119-24
A 90% Increase in Labor Efficiency. Sylvester. Apr., 249-52
LABOR-SAVING EQUIPMENT FEATURES NEW WESTINGHOUSE AIR BRAKE PLANT. Wildin. May, 337-42
**Loaders**
Crawler loader. (Industrial Equipment). May, 378
**Luckenbach, Robert H.**
Relation of Safety and Production. Jan., 25-8

M

**Machine Speeds**
Computing Relative Speeds of Machines Without Time Study. Mawson. May 371-2
**Machine Tool Industry**
Modern Design Features New Planer Plant. Cardullo. Apr., 261-5
**Machinery**
Hand Labor and Machinery as Producers. Polleys. Jan., 11-12
Speculators or Machine Builders. Feb., 128
MAINTAINING HOURLY CONTROL OF PRODUCTION. Brooke. Apr., 271-5
**Maintenance of System**
Keeping Up Improved Operating Results. Piacitelli. June, 435-9
MAJOR RESULTS OF BUDGETARY CONTROL. Clithero. May, 343-6
MAKER AND USER PROFIT BY NEW METHODS. Olin. June, 413-16
**Management** (See also Cost Accounting; Production Control; Wage Payment; also item in question)
Alignment Charts as Management Tools. Reuter. May, 367-8
Analyzing Net Worth in the Financial and Industrial Investigation. Andersen. Mar., 201-6
The Break-even-point Chart a Management Tool. Reuter. Apr., 290
Buick Saves $3,500,000 in Nine Months. Clark. Feb., 85-8
Cutting Labor Costs 37 Per Cent. Underwood. Feb., 119-24
The First Step in Manufacturing. Apr., 253-6
Improved Methods Double Production. O'Connor. May, 369-71
Judging Operating Results. Andersen. Apr., 277-80
Judging Organization and Personnel in the Financial and Industrial Investigation. Andersen. Feb., 113-17
Keeping Up Improved Operating Results. Piacitelli. June, 435-9

Management's Interest [illegible]. Perry. Jan., 45-50
Offsets for High Manufacturing Costs. Perry. Feb., 107-10
Operating and Balance Sheet Ratios. Andersen. May, 351-4
Operating and Balance Sheet Ratios. Andersen. June, 441-4
Patent Pooling Develops Auto Industry. Bauer. Mar., 207-9
Reducing Costs 22% by Motion Study. Piacitelli. Apr., 281-6
Reorganizing a Rundown Manufacturing Plant. Fish. Apr., 275-6
Scope of Financial and Industrial Investigations. Andersen. Jan. 17-22
Speculators or Machine Builders. Feb., 128
What Management Has Done for Us. Harmon. Jan., 51-4
Market Analyses Checks Over-Production. Willys. Mar., 165-8
Market (A) Survey and Its Results. Keely. May, 355-8
**Marketing**
The First Step in a Market Survey. Keely. May, 355-8
**Material Control**
Knitting Plant Material Control. Gates. June, 445-7
**Material Handling** (See also Coal Handling; also equipment in question)
Cutting Labor Costs 37 Per Cent. Underwood. Feb., 119-24
A Double Purpose Platform for Handling Material. Apr., 286
Handling Products in the Squibb Plant. Hagemann. Jan., 35-8
Hoisting Apparatus for Buildings. June, 430
Maker and User Profit by New Methods (Westinghouse iron manufacturer). Olin. June, 413-16
New Cost Basis for Material Handling. Moore. Mar., 169-70
A 90% Increase in Labor Efficiency. Sylvester. Apr., 249-52
Reducing Lumber Handling Costs. Feb., 111-12
Simplified Production and Handling. Edge. Feb., 93-6; Mar., 185-8
Solving Difficult Handling Problems. Travers. Apr., 287-9
Special Truck Cuts Handling Time in Half. Feb., 124
Two Novel Material Handling Methods. Mar., 184
**Mawson, Robert**
Computing Relative Speeds of Work to Save Time Study Expense. May, 371-2
**McQuinn, E. G.**
Bonus System Pays in Hoosier Plant. May, 329-34
**Metal Industry**
Solving Difficult Handling Problems. Travers. Apr., 287-9
**Mirror Industry**
Summarizing Costs for the Directors. Rosenthal. Apr., 179-84
Modern Design Features New Plywood Plant. Cardullo. Apr., 261-5
Modern (The) Manufacturing Plant. Atwater Kent Co. Ashworth. Jan., 7-10
**Moore, F. E.**
New Cost Basis for Material Handling. Mar., 169-70
**Mory, A. V. H. and Quigley, Leon V.**
How the Bigelow Corporation Profitably Manages Organized Research. Jan., 13-16
**Motion Study**
Keeping Up Improved Operating Results. Piacitelli. June, 435-9
Reducing Costs 22% by Motion Study. Piacitelli. Apr., 281-6; May, 347-50
**Motor Control**
Synchronous Motor Control. (Industrial Equipment). June, 455
**Motor Starter**
Oil Motor Starter. (Industrial Equipment). Mar., 217
**Motors** (See also Condensers)
Search for Economy Alters Motor Drive. Rogers. Mar., 171-4
Synchronous Motors. (Industrial Equipment). June, 455

N

Neglected (A) Phase of Cost Accounting. Robinson. Jan. 44
New Cost Basis for Material Handling. Moore. Mar., 169-70
**News of Manufacturing Industries**
Feb., 136; Mar., 218; Apr., 298; May, 390; June, 456
90% (A) Increase in Labor Efficiency. Sylvester. Apr. 245-8
Novel Budgets Cut Indirect Expenses. Harmon. Mar., 189-92

O

**O'Connor, Charles F.**
Improved Methods Double Production. May, 369-71
**Office Methods**
$52,000 Saved in Non-Productive Work. Heimstreet. June, 449-50
Offsets for High Manufacturing Costs. Perry. Feb., 107-10
Oil Burner and Preheater. Industrial Equipment. Jan. 60
**Oil Industry**
A 90% Increase in Labor Efficiency. Sylvester. Apr. 249-52
**Olin, E. M.**
Maker and User Profit by New Methods. (Westinghouse iron manufacture). June, 413-16
Operating and Balance Sheet Ratios. Andersen. May 351-4
Operating and Financial Status. Andersen. Jan. 44
**Operating Statements**
Judging Operating Results. Andersen. Apr., 277-80
**Orders**
Foreseeing Volume of Coming Orders. Barber. Apr., 253-6
Short Cuts to Accurate Order-Filling. Aldrich. May, 335-6
**Organization**
The First Step in Manufacturing. Apr., 256
Judging Organization and Personnel. Andersen. Feb., 113-17

P

**Packing** (See Shipping Containers)
**Packing Industry**
Major Results of Budgetary Control. Clithero. May, 343-6
Panelboard for Industrial Use. Industrial Equipment. May, 379
**Paper Manufacturing**
Coal Handling and Boiler Operation at Northern Paper Mills. Gochnauer. Jan., 23-4
Cost of a Short-Sighted Power Policy. Sheehan. Mar., 193-4
Successful Budgetary Control of Production in Fine-Paper Mills. Grasselt. Apr., 257-60
Patent Pooling Develops Auto Industry. Bauer. Mar., 207-9
Peerless Portland Cement Pioneers in Plant Design and Layout. Gillespie. Mar., 195-200
**Perry, Thomas D.**
Management in Lumber Dry Kilns. Jan., 45-50
Offsets for High Manufacturing Costs. Feb., 107-10
**Personnel**
Judging Organization and Personnel. Andersen. Feb., 113-17
**Piacitelli, Joseph A.**
Keeping Up Improved Operating Results. June, 435-9
Reducing Costs 22% by Motion Study. Apr., 281-6; May, 347-50
**Pipe Threaders**
Portable Power Pipe Threader. (Industrial Equipment). May, 379
**Platforms**
A Double Purpose Platform for Handling Material. Apr., 286
Steel-Bound Platforms (for lift trucks). (Industrial Equipment). June, 455
"Please Clean This Car." Jan., 28
**Polleys, Rhodes**
Hand Labor and Machinery as Producers. Jan., 11-12
**Power Equipment** (See device in question)
**Power Plant Operation**
Coal Handling and Boiler Operation at Northern Paper Mills. Gochnauer. Jan., 23-4
Cost of a Short-Sighted Power Policy. Sheehan. Mar., 193-4
Scientific Planning for the New Western Electric Plant. Spurling. Feb. 101-6
**Power Transmission**
Search for Economy Alters Motor Drive. Rogers. 171-4
**Pricing**
Pricing for Profit vs. Pricing for Volume. Churchill. Apr., 267-70
Unfair Selling Prices. Churchill. Feb., 97-100
What Should the Net Profit Be? Churchill. Mar., 175-8
**Printing Press Manufacturing**
An Effective Production Control System. Swan. Jan., 39-43
Simplified Production and Handling. Edge. Feb., 93-6; Mar., 185-8
**Production**
Hand Labor and Machinery as Producers. Polleys. Jan., 11-12
Maker and User Profit by New Methods (Westinghouse iron manufacture). Olin. June 413-16
Relation of Safety and Production. Luckenbach. Jan., 25-8
**Production Control** (See also Management)
An Effective Production Control System. Swan. Jan., 39-42
Maintaining Hourly Control of Production. Brooke. Apr., 271-5
Market-Analyses Checks Over-Production. Willys. Mar., 165-8
Simplified Production and Handling. Edge. Feb., 93-6; Mar., 185-8
Successful Budgetary Control of Production in Fine-Paper Mills. Grasselt. Apr., 257-60
A Handy Guide to Manufacturing Control. Barber. June, 417-20
**Profits**
Industrial and Public Utility Profits in 1925. Apr., 260
Pricing for Profit vs. Pricing for Volume. Churchill. Apr., 267-70
What Should the Net Profit Be? Churchill. Mar., 175-8
Program (A) for 1926. Jan. 5-6
**Public Utilities**
Industrial and Public Utility Profits in 1925. Apr., 260
**Purchasing Power**
General Motors Purchasing Power Index. Weaver. Apr., 291-2

Q

**Quality Control**
Cadillac Keeps Strict Watch on Quality. Fisher. June, 409-12
Finding Causes of Quality Variations. Shewhart. Feb., 125-8
**Quigley, Leon V.** (See Mory, A. V. H.)

R

**Radio Manufacturing**
The Modern Manufacturing Plant. Ashworth. Jan., 7-10
REAL RELATION OF WAGES AND LIVING COSTS. Stowell. June, 448
RECLAMATION PROCESS APPLIED TO WATER. Mar., 174
**Recording Instruments** (See Indicating and Recording Instruments)
REDUCING COSTS 22% BY MOTION STUDY. Piacitelli. Apr., 281-6; May, 347-50
REDUCING LUMBER HANDLING COSTS. Feb., 111-12
RELATION OF SAFETY AND PRODUCTION. Luckenbach. Jan., 25-8
REORGANIZING A RUNDOWN MANUFACTURING PLANT. Fish. Apr., 275-6
**Research**
How the Bakelite Corporation Effectively Manages Organized Research. Mory and Quigley. Jan., 13-16
Keeping Research on a Business Basis. Hagemann. May, 359-62
Testing Products from the User's Angle (General Motors proving ground). Hagemann. June, 431-4
**Reuter, F. J.**
Alignment Charts as Management Tools. May, 367-8
The Break-even-point Chart a Management Tool. Apr., 290
**Rheostats**
Field Rheostats. (Industrial Equipment). Apr., 297
**Robinson, J. W.**
A Neglected Phase of Cost Accounting. Jan., 44
**Rogers, R. H.**
Search for Economy Alters Motor Drive. Mar., 171-4
**Rosenthal, Rudolph**
Summarizing Costs for the Directors. Mar., 179-84
**Rossy, M. S.**
Keeping Down the Cost of the Factory Dispensary. Jan., 55
**Rubber Industry**
Novel Budgets Cut Indirect Expenses. Harmon. Mar., 189-92
What Management Has Done for Us. Harmon. Jan., 51-4

S

**Safety**
Relation of Safety and Production. Luckenbach. Jan., 25-8
Safety Progress Requires Better Records. Mar., 211
SAVING MONEY ON SHIPPING CONTAINERS. Feb., 129-30
**Saw, Woodworking**
Portable Universal Saw. (Industrial Equipment). June, 455
SCIENTIFIC PLANNING FOR THE NEW WESTERN ELECTRIC PLANT. Spurling. Feb., 101-6
SCOPE OF FINANCIAL AND INDUSTRIAL INVESTIGATIONS. Andersen. Jan., 17-22
**Scrap**
A Fence Made from Scrap. Edwards. Jan., 50
SEARCH FOR ECONOMY ALTERS MOTOR DRIVE. Rogers. Mar., 171-4
**Selling** (See Pricing)
**Sheehan, Andrew F.**
Cost of a Short-Sighted Power Policy. Mar., 193-4
**Shewhart, W. A.**
Finding Causes of Quality Variations. Feb., 125-8
**Shipping**
Effect of Knots on Strength of Bracing for Carload Freight. Johnson. June, 440
**Shipping Containers**
Saving Money on Shipping Containers. Feb., 129-30
SHORT CUTS TO ACCURATE ORDER FILLING. Aldrich. May, 335-6
SIMPLE STOREROOM AND STORAGE YARD METHODS. Mar., 210
SIMPLIFIED PRACTICE PROGRESS. Jan., 43
SIMPLIFIED PRODUCTION AND HANDLING. Edge. Feb., 93-6; Mar., 185-8
**Soldering Iron**
Electric Soldering Iron. (Industrial Equipment). May, 37-9
SOLVING DIFFICULT HANDLING PROBLEMS. Travers. Apr., 287-9
SPECIAL TRUCK CUTS HANDLING TIME IN HALF. Feb., 124
SPECULATORS OR MACHINE BUILDERS. Feb., 128
**Spurling, O. C.**
Scientific Planning for the New Western Electric Plant. Feb., 101-6
**Stock Control**
Visible Index for May, 350
**Storage**
Simple Storeroom and Storage Yard Methods. Mar., 210
**Stowell, L. M.**
Real Relation of Wages and Living Costs. June, 448
SUCCESSFUL BUDGET INSTALLATION. Tharp. Feb., 89-92
SUCCESSFUL BUDGETARY CONTROL OF PRODUCTION IN FINE-PAPER MILLS. Grasselt. Apr., 257-60
SUMMARIZING COSTS FOR THE DIRECTORS. Rosenthal. Mar., 179-84
**Switches**
Magnetic Switches for A. C. Motors. Mar., 217
Magnetic Switch for Woodworking Machines. (Industrial Equipment). Jan., 60
**Swan, John J.**
An Effective Production Control System. Jan., 39-43
**Sylvester, L. A.**
A 90% Increase in Labor Efficiency. Apr., 245-8

T

**Telephone Equipment Manufacturing**
Finding Causes of Quality Variations. Shewhart. Feb., 125-8
Scientific Planning for the New Western Electric Plant. Spurling. Feb., 101-6
TESTING PRODUCTS FROM THE USER'S ANGLE. Hagemann. June, 431-4
**Textile Industry**
Budgeting the Textile Industry. Tharp. Jan., 29-34
Knitting Plant Material Control. Gates. June, 445-7
Successful Budget Installation. Tharp. Feb., 89-92
**Textile Machinery Industry**
Improved Methods Double Output. O'Connor. May, 369-71
Short Cuts to Accurate Order-Filling. Aldrich. 335-6
**Tharp, Carey E.**
Budgeting the Textile Industry. Jan., 29-34
Successful Budget Installation. Feb., 89-92
TIMELY (A) GUIDE TO MANUFACTURING CONTROL. Barber. June, 417-20
**Traffic Rules**
Employee Traffic Rules. May, 346
TRAFFIC SPOTS. Industrial Equipment. May, 379
**Trailer Car**
Industrial Trailer. (Industrial Equipment). May, 379
**Transformer**
Shovel-Type Transformer. (Industrial Equipment). June, 455
**Travers, James B.**
Solving Difficult Handling Problems. Apr., 287-9
**Trucks** (See also Platforms)
Elevating Platform Truck. (Industrial Equipment). June, 455
Light Duty Hand Lift Truck. (Industrial Equipment). Jan., 60
Six-Ton Hy-Lift Truck. (Industrial Equipment). Jan., 60
Special Truck Cuts Handling Time in Half. Feb., 124
**Turnover**
Operating and Turnover Ratios. Andersen. June, 441-4
TWO NOVEL MATERIAL HANDLING METHODS. Mar., 184

U

**Underwood, Charles N.**
Cutting Labor Costs 37 Per cent. Feb., 119-24
UNFAIR SELLING PRICES. Churchill. Feb., 97-100

V

**Vacuum Cleaners**
Pneumatic Sweeper System. (Industrial Equipment). June, 455
Portable Vacuum Cleaner. (Industrial Equipment). Apr., 297
**Valve and Fitting Industry**
A Timely Guide to Manufacturing Control; the Valve and Fitting Index. Barber. June, 417-20
VISIBLE INDEX FOR STOCK CONTROL. May, 350

W

**Wage Payment**
Barth Standard Wage Scale. May, 373-4
Bonus System Pays in Hoosier Plant. McQuinn. May 329-34
Cutting Labor Costs 37 Per Cent. Underwood. Feb., 119-24
Real Relation of Wages and Living Costs. Stowell. June, 448
What Determines Wages in Industry. Cox. Apr., 245-8
**Waste Reclamation**
Reclamation Process Applied to Water. Mar., 174
**Weaver, H. G.**
General Motors Purchasing Power Index. Apr., 291-2
**Welding Equipment**
Resistance Welders. (Industrial Equipment). May, 379
Welding Torch. (Industrial Equipment). June, 455
WHAT DETERMINES WAGES IN INDUSTRY. Cox. Apr., 245-8
WHAT MANAGEMENT HAS DONE FOR US. Harmon. Jan., 51-4
WHAT SHOULD THE NET PROFIT BE? Churchill. Mar., 175-8
**Wildin, G. W.**
Labor-saving Equipment Features New Westinghouse Air Brake Plant. May, 337-42
**Willys, John N.**
Market-analysis Checks Over-production. Mar., 165-8
**Woodworking Industries**
Bonus System Pays in Hoosier Plant. McQuinn. May, 329-34
Management in Lumber Dry Kilns. Perry. Jan., 45-50
Offsets for High Manufacturing Costs. Perry. Feb., 107-10
Reducing Lumber Handling Costs. Feb., 111-12

*"We never know how little we make (or save), until we know how much we WASTE"*

# YOUR WORKING FORCE x $1,000.00!

Add together the number of your firm members, salaried employees and wage earners. Multiply this total by $1,000.00

**This will represent what your annual preventable waste, in man power, equipment, materials and overhead expense, is supposed to be, as an average.**

This can be divided:

| | |
|---|---|
| *A* — Waste for which labor is responsible | 24% |
| *B* — Waste for which management is responsible | 60% |
| *C* — Waste for which management and labor are responsible | 84% |
| *D* — Waste due to external causes | 16% |
| *E* — Total | 100% |

Ratio *B* to *A* = 2.5 to 1.0

Waste, in the best plants to that in the average plants, ranges from 1 : 1½ to 1 : 4½.

**These questions are, therefore, pertinent, What is the ratio of your actual waste to your calculation? To that of the best plants in your industry?**

C. J. Stark, President, Penton Publishing Company, Cleveland, Ohio, has said:

"While volume has been large, margins of profit have been the smallest relatively ever known ——"

**Why? Too much waste in industry!**

Would it not be well to consult us regarding a Waste Elimination Program? This can be done at your convenience, without obligation to you.

**Why not arrange for this Conference immediately?**

## WASTE ELIMINATORS

Incorporated

C. E. KNOEPPEL, *Managing Director*

PARK SQUARE BUILDING BOSTON, MASSACHUSETTS

*A Division of Bigelow, Kent, Willard & Co., Inc.*

FOR YOUR CONVENIENCE

Waste Eliminators, *Incorporated*, Date
Park Square Building,
Boston, Massachusetts.
*Gentlemen*

Understanding that it will be without obligation to us, you may arrange for a personal conference with us to discuss the matter of a Waste Elimination Program, on or about ....., 1926.

Company City

Person to see Title

Person signing ..... Title

# Simplify Factory Painting

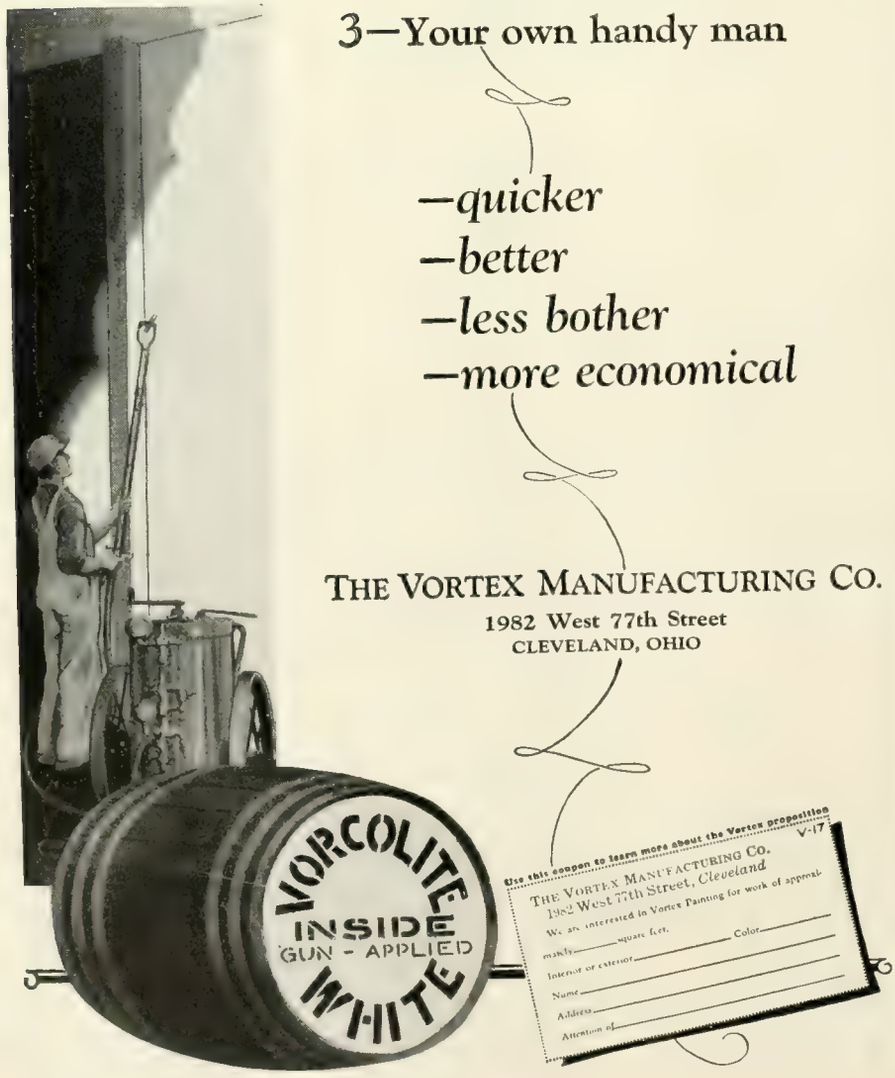
by using

1—VORCOLITE, *flat white*

2—Our painting equipment (*loaned to you*)

3—Your own handy man

*—quicker*
*—better*
*—less bother*
*—more economical*




THE VORTEX MANUFACTURING CO.
1982 West 77th Street
CLEVELAND, OHIO


in 1915, is to be dissolved after approval of the dissolution plan by the stockholders. The reason for dissolution is to end confusion in identities of the two companies.

**Eureka Vacuum Cleaner Company.**—For the first four months of this year the company sold 88,453 machines, compared with 74,840 machines in the same period of last year. Sales during the month of April were 24,000 machines as compared with 14,430 in April of last year, and profits for the month of April are expected to exceed those of the entire second quarter of last year. Unfilled orders now amount to 19,000 machines. Net sales in the first quarter of the year amounted to $2,781,055, compared with $2,337,237 in the same quarter of last year.

**Fairbanks, Morse & Company.**—

| Quarters ended March 31 | 1926 | 1925 |
|---|---|---|
| Gross income | $2,455,168 | $2,030,340 |
| Expenses | 1,604,430 | 1,367,747 |
| Depreciation | 218,828 | 205,509 |
| Pension fund | 28,447 | 25,414 |
| Federal taxes | 78,450 | 51,959 |
| Preferred dividends | 131,706 | 131,706 |
| Common dividends | 276,654 | 239,766 |
| Balance, surplus | $116,652 | $8,240 |

**Flour Mills of America, Inc.**, has sold $3,500,000 20-year 6½ per cent convertible gold notes, series A, and 25,000 shares designated $8 cumulated preferred stock. The profits from these sales will be used to acquire the ownership, properties and assets of the Kansas Flour Mills Company, and the properties, trade-marks, brands and good will of the Valier & Spies Milling Company.

**Ford Motor Company of Canada.**—The company produced 29,706 cars and trucks in the first quarter of this year against 23,424 in the corresponding period in 1925. March production was 11,125 cars and trucks compared with 9,149 for March last year and with 10,526 for February and 8055 for January this year.

**French Battery Company.**—G. Charter Harrison, who is so well known to readers of MANUFACTURING INDUSTRIES for his many constructive papers and articles, has just been elected director and vice president of the company. Mr. Harrison joined the organization last July, taking the position of general sales manager.

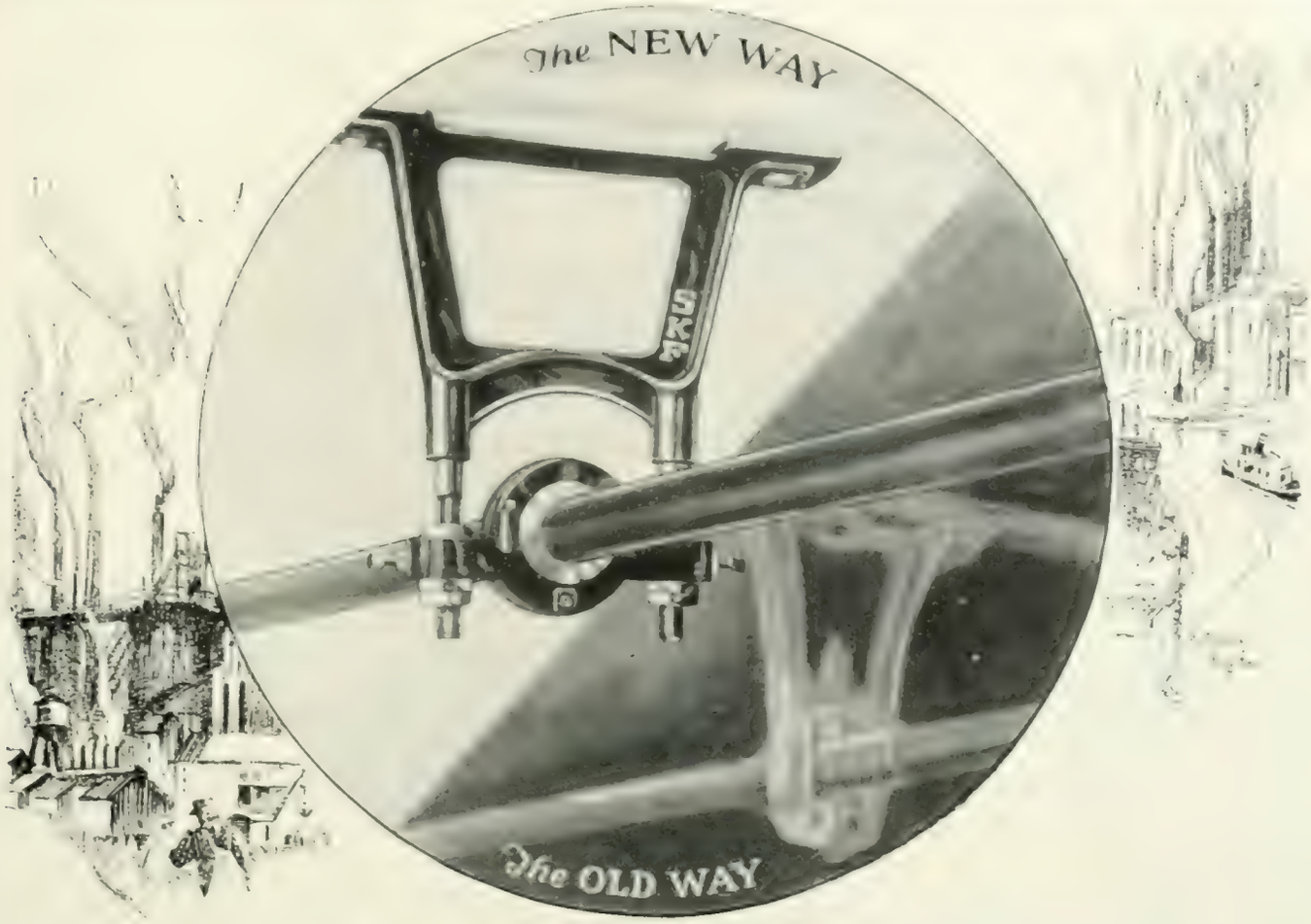
**General Electric Company.**—Stockholders of the General Electric Company have approved a plan to change the present authorized common stock issue of 1,850,000 shares of $100 par value to 7,400,000 shares of no-par common stock.

**General Refractories Company.**—

| Three months ended March 31 | 1926 | 1925 |
|---|---|---|
| Net after expenses | $493,703 | $551,786 |
| Interest, taxes, etc | 133,329 | 145,284 |
| Depreciation and depletion | 60,691 | 59,627 |
| Dividends | 112,500 | 112,500 |
| Surplus | $187,183 | $234,375 |

**Gillette Safety Razor Company.**—It is reported that the company has acquired

*(Continued on page 464)*




# Cutting 53.04 H. P. *off the power load**

TO prevent shaft bearings running hot and whining for oil, power costs running high and out of all proportion to the amount of power actually used by old plain bearings, which constantly demand attention and repairs — install Skayef Self-Aligning Ball Bearing Hangers.

A Southern cotton mill*, not only reduced labor and lubricant costs, but cut 53.04 H. P. off the power load as soon as Skayef equipment was installed.

Skayef engineers will show you how Skayef line shaft equipment will reduce your power and maintenance costs, speed up production, eliminate expensive delays and pay for itself in less than two years.

* *A certified survey of this installation sent on request.*

The SKAYEF BALL BEARING COMPANY, 165 Broadway, New York

1543

BALL BEARING

# SKAYEF HANGERS

POST HANGERS, PILLOW BLOCKS SKF Puts the Right Bearing in the Right Place AND TRANSMISSION APPLIANCES

*Every parcel shipped by mail has money value*

NORTH America Parcel Post Insurance does not cover currency sent through the mail. Yet every package mailed is money in an equally losable form. Insurance is your only protection against financial loss on packages, and a North America Coupon Book represents dependable insurance in its most convenient form. Wrap a North America Coupon in every package and you are assured of satisfactory adjustment without red tape or delay. Ask your insurance agent, or write for complete information.

**Insurance Company of North America**
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*"The Oldest American Fire and Marine Insurance Company"*
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Philadelphia, Pa., Dept. D-6

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City ..... State .....
Wants information on Parcel Post Insurance

a majority interest in the Roth Buchner Company, the largest manufacturer of safety razor blades in Germany, and has also purchased the entire capital stock of a large Austrian manufacturer. Present organizations of these companies will be retained and they will continue to market blades under their trade name as before. From $1,000,000 to $1,500,000 is involved in the purchase of stocks of these German and Austrian companies.

**Graton and Knight Mfg. Company.**—The directors have declared the reorganization plan operative. This will result in the transfer of the assets of this company to a new company to be known as the Graton & Knight Corporation. Frank H. Willard becomes president of the new company, succeeding John E. White, who has been president of the Graton & Knight Mfg. Company.

**Hudson Motor Car Company.**—A gain in Hudson and Essex buyers of 53 per cent in the first three months of 1926, as compared with a similar period of 1925, is announced by Roy D. Chapin, chairman of the board. These figures, just compiled, show that 55,000 Hudson and Essex cars were sold to owners in this period as compared to 36,000 in 1925.

**Hupp Motor Car Company.**—Number of cars produced, month of

| | |
|---|---|
| April | 3,799 |
| March 1926 | 4,732 |
| April 1925 | 3,665 |

**Industrial Rayon Corporation.**—Bertrand R. Clarke has become president of this corporation, and its subsidiary, the Industrial Fibre Corporation of America. A plan has been developed to acquire all of the outstanding securities of the present subsidiaries of the corporation, so there will be but one large company.

**Inland Steel Company** on May 4 formally fired the new blast furnace at its plant at Indiana Harbor. This furnace is one of the largest in the Mid-West, cost $1,500,000 and will have a daily output of 700 tons of pig iron. It is so designed that it can be operated by four men instead of the usual crew of 12.

**International Combustion Engineering Corporation** reports net income for 1925 of $1,006,919, after interest, depreciation, Federal Taxes and other charges, as against earnings in 1924 of $1,056,406. The 1925 earnings are equal to $2.21 a share earned on 454,545 average number of no-par shares outstanding, against $2.41 a share on 437,934 shares in 1924.

**International Harvester Company.**—Issuance of $10,000,000 of new preferred stock to carry on stock ownership among employees was voted at the annual meeting of the International Harvester Company.

When the plan was first announced, in

*(Continued on page 466)*

# "Ignorance is the cause of economic waste"

—said Mr. O. H. Cheney, Vice-President of the American Exchange-Pacific National Bank, New York City, in a recent address. "Ignorance of the facts of supply and demand is the cause of troubles which afflict the separate industries. Ignorance of efficient business methods is the cause of individual failure."

There is no need, today, for the individual business man to be in the dark about conditions and improved practice in his field. The business press particularly those publications belonging to the A.B.P., are serving industry better and more completely than ever before.

*Fight waste with facts from A. B. P. papers*

Get the most out of your business paper. Read its editorials for the worth-while opinions of men who know. Read its technical articles to keep pace with current developments. Read its advertisements for dollar-saving suggestions.

You fight waste with facts when you get your information from an A.B.P. publication—this one, for example. High standards of accuracy in editorial as well as advertising content are exacted as a condition of membership in the Associated Business Papers, Inc.

Advertisers in A.B.P. papers are combating selling waste by reaching selected groups of readers who are searching for just such economical suggestions as the advertisers have to offer.

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*An Association of none but qualified publications reaching 56 fields of trade and industry.*


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# what price upkeep—

Repairs, replacements, and the annoyance that goes with them are not wholly inevitable.

For instance, where metal enters into construction—COPPER, BRASS and BRONZE, appropriately used, reduce or entirely eliminate the expense caused by repair or renewal of rusted parts.

In home, office or plant, used as BRASS pipe plumbing, as COPPER flashings, gutters and downspouts, as BRASS or BRONZE hardware and lighting fixtures these metals do not rust.

Freedom from expense and trouble assured by COPPER, BRASS and BRONZE warrants their use.

COPPER & BRASS
RESEARCH ASSOCIATION
25 Broadway, New York


May, 1924, the stockholders authorized issuance of $15,000,000 preferred stock, all of which was taken by 22,000 employees, or 60 per cent of the company's force. The average holding is $680. The number of shares held by the employees is 38,485. It is estimated that employees are investing at a monthly rate of $250,000.

**International Match Corporation and Constituent Companies.—**

| Calendar years | 1925 | 1925 |
|---|---|---|
| Sales | $31,494,630 | $21,164,297 |
| Income from interest and other sources | 3,421,522 | 3,180,558 |
| Net income | $34,916,152 | $24,344,855 |
| Operating expenses (including taxes) | 22,487,831 | 15,111,242 |
| Allowance for depreciation | 1,731,717 | 1,610,586 |
| Writing off discount and other expenses | | 2,533,700 |
| Dividends on participating pref. ($2.90) | 2,023,713 | |
| Balance, surplus | $8,672,890 | $5,089,327 |
| Previous surplus | 5,725,291 | 635,964 |
| Premium on preferred stock | 3,833,080 | |
| Surplus | $18,231,261 | $5,725,291 |

**Lindley-Dunning Mfg. Company** has been incorporated to manufacture pumps and equipment for electrical refrigeration. Elmer D. Dunning, formerly vice-president and general manager of the Dunning Compressor Company, has given up all active duties in that organization and is devoting all his attention to the new company and its production.

**Los Angeles Knitting Company, Inc.,** has just started the erection of a new plant at Hollydale, Calif. The first unit will be a one-story building 150 by 150 ft. in size and will employ 100 workers. It is expected that this building will be completed by July 1, 1926.

**McCallum Hosiery Company.**—The directors have declared a stock dividend of 50 per cent, payable to holders of record April 20, thus capitalizing $1,450,000 surplus, which on December 31 last stood at $2,563,996. The company has changed its capital stock from 500 shares of $100 par to 60,000 shares of no par, all of which are outstanding. Additional stock of 35,000 shares has been authorized, of which 30,000 shares are to be issued as the stock dividend.

**Morse Dry Dock & Repair Company** has announced the purchase of the ship repair yard known as the Alderton Dock Yards, Ltd., facing on Gowanus Bay at the foot of 17th, 18th, and 19th Streets, Brooklyn, N. Y. The plant is being overhauled and will include two modern floating dry docks, one of 8000 tons and the other of 10,000 tons capacity.

**Munsingwear Corporation** has acquired a controlling interest in the Thieme Bros. Company at Fort Wayne, Indiana, the seller being the Real Silk Hosiery Mills, Inc.

**Music Master Corporation.**—A decree declaring the corporation bankrupt was en-

*(Continued on page 468)*


# 5000 Readers of 1000 Plant Subscriptions

**Facts from a Questionary sent to company subscribers of MANUFACTURING INDUSTRIES**

| | Number | Percentage |
|---|---|---|
| Presidents | 300 | 6. |
| Vice-Presidents | 260 | 5.2 |
| General Managers | 490 | 9.6 |
| Works Managers | 320 | 6.3 |
| Treasurers | 340 | 6.7 |
| Secretaries | 310 | 6.1 |
| Engineers | 520 | 10 1 |
| Production Managers | 370 | 7 3 |
| Superintendents | 550 | 10 8 |
| Planning Superintendents | 190 | 3 7 |
| General Foremen | 80 | 1 7 |
| Purchasing Agents | 330 | 6.5 |
| Foremen | 30 | 0.6 |
| Inspectors | 20 | 0.4 |
| Overseers | 40 | 0.8 |
| Supervisors | 110 | 2.2 |
| Other Executive Positions | 850 | 16.8 |

RUTLEDGE BERMINGHAM
**Advertising Manager**

PEASE PEERLESS MACHINE

Turns out finished prints [illegible]

# "The Pease Machine Saves Us the Labor of One Man"

Four years ago, the Peerless Motor Car Company, Cleveland, Ohio, replaced another type of blue printing machine that required separate washing and drying with a Pease Peerless that prints, washes, and dries—all in one operation. Substantial savings were immediately noticed in the cost of producing blue prints.

## Produce 1,000 Prints Daily

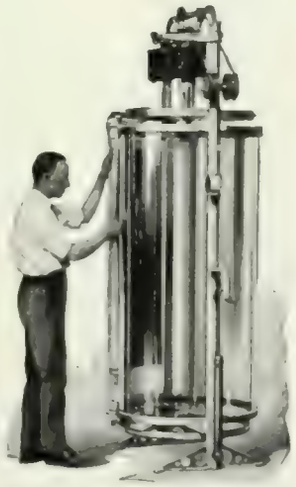
Today, the Peerless Motor Car Company are making about 1,000 blue prints daily. They blue print piece part drawings, assembly drawings, stock sheets, material specifications, prints for estimates, patent sketches, factory schedules, management charts, engineering and experimental department curves—anything of an engineering nature requiring duplication. Each model requires 3,500 different piece part drawings, copies of which are distributed among seven factory departments.

In commenting about the tremendous savings the Peerless Motor Car Company are making, Mr. A. L. Neal, Chief Draftsman, says: "Our prints run from 6 x 9 inches to 36 inches by 12 feet in size—most being 9 x 12 inch prints of the piece parts.

"The Pease Machine is meeting the present heavy demand for Peerless car production most satisfactorily. On our present blue print production, the Pease Machine saves us the labor of one man, as compared to the old hand drying method."

The savings the Peerless Motor Car Company make by having their own blue printing equipment is typical of hundreds of plants. Wherever Pease Blue Printing Machinery is used, substantial savings are reported. If you use blue prints in volume, it will pay you to investigate Pease equipment.

Let us send you a copy of our new catalog and reports showing how Pease equipment is saving money in every line of business. You are not obligated in any way.



PEASE VERTICAL MACHINE

Receives [illegible] Get the facts about this machine.

## THE C. F. PEASE COMPANY

823 N. Franklin St., Chicago

# PEASE

## BLUE PRINTING MACHINERY

LET BLUE PRINTS TELL YOUR STORY

# *for the Manager Concerned with Finances*

Here, concentrated between two covers, is more information on practical financial management for manufacturing men than you can get anywhere else in printed form at any price—

## Financial Handbook

ROBERT H. MONTGOMERY, *Editor*

*Member of the firm, Lybrand, Ross Bros. & Montgomery; Certified Public Accountant; Counselor-at-Law*

ORGANIZES for quick reference the substance of every aspect of handling the finances of a business. Contains 1749 pages of material, so condensed and arranged as to be the equivalent, in content, of fully 4000 of ordinary style, or 10 large volumes. 34 big sections—see list at left.

***Covers Tremendous Range of Material*** Whether your organization is large or small, you will meet few questions of financial policy or detail for which this great Handbook will not give you the basic data you need for a sound, positive decision.

A few minutes spent each day in reading over its pages—in fact, simply the constant use of it—will in a very short time give you a remarkable grasp of financial methods and policies.

***Prepared by Able Specialists*** 32 able contributors worked over a period of two years to assemble the material for this volume. Robert H. Montgomery, the Editor, has for more than 25 years played a prominent part in the financial management of well-known companies in every line of business and industry.

***"Best Reference Book on My Desk"***

"Far and away the best reference book on my desk. Material is terse, well arranged and almost perfectly indexed."—*A. B. Byler, Vice-President and General Manager, Edison Electric Appliance Co., Chicago, Ill.*

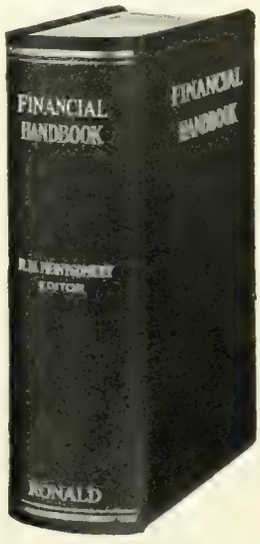
### Sent You for Examination

Managers and officials in manufacturing companies, accountants, credit men—executives who handle finances everywhere, regardless of rank or title—are buying the *Financial Handbook* eagerly. It sells for $7.50, an almost incredibly low price for so wonderfully complete and so handsomely manufactured a volume.

Have a copy sent postpaid. Within five days after receiving it you may either return it if it does not meet your needs or send us your check for the price. Address Dept. M-80

**The Ronald Press Company**
**Publishers :: 15 E. 26th St., New York, N. Y.**

Now in its 6th Printing




### 34 Sections

Control of Current Operations
Capital Structure and Policies
Fixed Capital Expenditures
Control of Sales and Sales Expense
Budgets
Insurance Protection
Controlling Inventory Investment
Cost Determination
Credits and Collections
Financial Statements and Reports
Security Markets
Business Law
Export and Import Procedure
Purchase and Sales Terms
Foreign Exchange and Financing
Dealings with Embarrassed Debtors
Purchasing
Traffic Management
Mathematics of Finance
Fundamentals of Business Economics
Real Estate Transactions
"Blue Sky" Laws
Federal Taxes
Transportation Rates
Treasurer — Comptroller — Secretary (Functions, Duties, Etc.)
Banks and Their Uses
Profit-Sharing Plans
Accounts and Audits
Abbreviations of Business Terms
Federal Regulation of Business
Investing Surplus Funds
Types of Business Organization
Business Statistics
Fiduciary Relations

*1749 Pages—Gilt Edges*
*Sturdy Flexible Binding*


tered in the U. S. District Court at Philadelphia, May 4, and the affairs of the company were placed under the control of C. H. Stinson, of Norristown, Pa., referee in bankruptcy. Liabilities are estimated at $1,200,000 and assets at $400,000.

**National Acme Company** reports for the quarter ended March 31 a net profit of $227,568 after interest and depreciation, which was equal to 45 cents a share of the 500,000 shares of $10 par stock. This compares with $64,284, or 12 cents a share, in the first quarter of 1925.

**National Biscuit Company.**—This company has recently purchased the controlling interest in the National Milling Company of Toledo, Ohio, which has a production of 4000 barrels of flour daily.

**National Cash Register Company.**—Consolidated net profit of the National Cash Register Company for the first quarter was $1,206,278, after expenses, depreciation and Federal taxes, compared with $1,469,166 in the corresponding period of last year. A large part of the decrease is due to a substantial increase in advertising expenses and also to reduced profits from the foreign business in January and February.

**Paige-Detroit Motor Car Company.**—

| Month of April | 1926 | 1925 |
|---|---|---|
| Number of cars shipped | 4,623 | 4,080 |

**Paraffine Companies, Inc.**—The preferred stockholders have been given the right to exchange their holdings on May 31 next for common stock on the basis of 1¼ shares of common for one share of preferred. No fractional shares will be issued, but stockholders may either sell or purchase fractions at the rate of $93 a share for the common stock.

**Power Specialty Company** has purchased the Aero Pulverizer Company, manufacturer of Aero Unit Coal Pulverizers.

**Albert Pick, Barth & Company, Inc.**—The annual earnings statement of Albert Pick, Barth & Co., Inc., representing the recent merger of Albert Pick & Co. of Chicago, and L. Barth & Co. of New York, shows total sales for 1925 of $26,497,784. This compares with sales in 1924 of $22,739,391.

**Procter & Gamble Company.**—Charles W. Dupuis has been elected director of the Procter and Gamble Company.

**Railway Steel Spring Company** is to be merged with the American Locomotive Company by action of the stockholders of the latter company in approving the plan. The number of directors of the American Locomotive Company has been increased from 11 to 15.

**Ryerson & Son, Inc.** has purchased the

(Continued on page 477)

# Without this label it is not a true Steel Bound

If the Steel Bound Platforms you buy do not carry the above label, they are not the true, original, Patent Bound Stuebing-built unit.

They will not wear as well—last as long—be as safe—nor will they carry the protection and the backing of The Stuebing-Cowan Company. Stuebing units alone are built to Stuebing specifications for service regardless of cost.

*A copy of Stuebing Steel Bound specifications or a Steel Bound platform will be sent for comparison. Which would you prefer—write.*

**The Stuebing-Cowan Company**

**Cincinnati, Ohio** **Holyoke, Mass.**

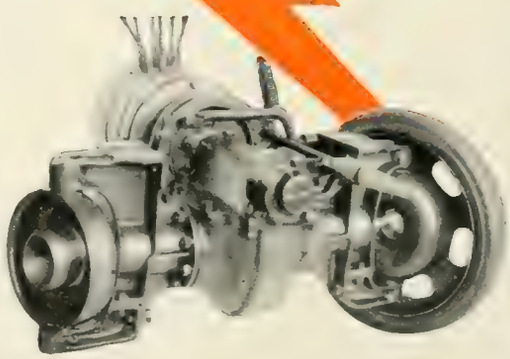
# Controlled Brute Strength

## COWAN

THERE'S no mystery about the success of Cowan Electric Trucks and Tractors. It's their brute strength that accounts for remarkable ability to out-run, out-pull, out-lift and out-wear other types of electrics. But brute strength uncontrolled would be cumbersome, unwieldy. Cowan Electrics have, in addition, speed, ease of control, quick safety,—a complete combination of qualities that cuts handling costs 40 to 60 per cent.

Conclusive proof of their superiority is the repeat orders from General Electric, Compton-Knowles, Pierce-Arrow, John A. Roebling, and many others of equal calibre, who buy on a basis of efficiency records.

Write or wire for literature. Experience of years is at your service without cost or obligation.



The Stuebing-Cowan Company

Holyoke, Massachusetts Cincinnati, Ohio

StueBing

THE LARGEST MANUFACTURERS OF HAND AND ELECTRIC LIFT TRUCKS

*Tycos* Instruments in one of the mixing rooms of the Wm. Wrigley Jr. Co.

## *Perfect Humidity Control Since Using*

# *Tycos* Thermometers and Hygrometers

In the manufacturing of chewing gum, perfect temperature and humidity conditions must be maintained or the gum will deteriorate.

A too moist air condition makes the gum soft and sticky. Then it cannot be worked. If the temperature is too dry or warm, the gum becomes hard and brittle.

The temperature and humidity of the plant must be kept at the right temperature throughout the entire process.

The Wm. Wrigley Jr. Company have solved the problem by installing *Tycos* Recording Thermometers and Hygrometers throughout their entire plant. Now they have perfect temperature and humidity control. The charts indicate at all times the temperature and humidity of each room. Hourly a man visits each *Tycos* Recording Thermometer to check up on the air conditions. This prevents spoilage and speeds up production.

There are *Tycos* Instruments for indicating, recording and controlling the temperature or pressure for thousands of different operations. It may be the roasting of coffee, the japanning of sheet steel, the keeping track of steam, water, lime, ammonia, oil or gas temperatures, the drying of lumber, the treating of metals — whatever the operation, *Tycos* Instruments will do the job thoroughly and accurately.

We shall be glad to send our *Tycos* Catalog giving complete information, or one of our Engineers will visit your plant and suggest ways to safeguard your process.

*Taylor Instrument Companies*

Rochester, N. Y., U. S. A.

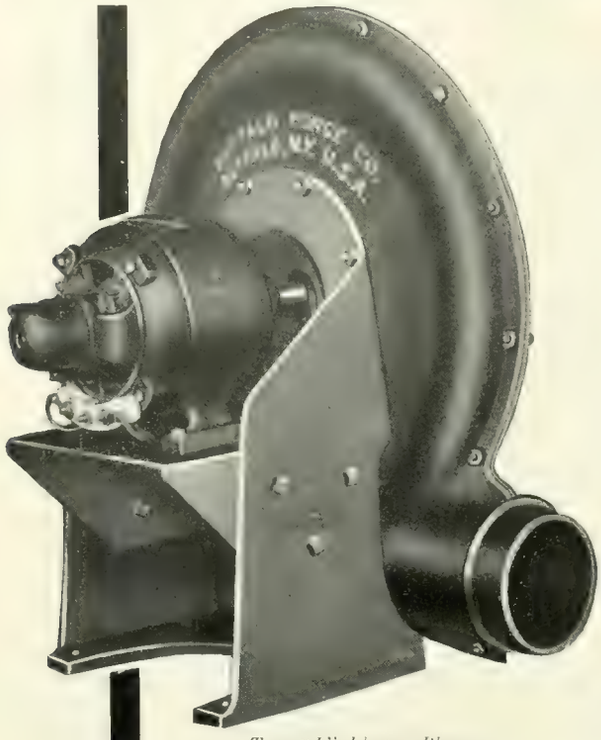
Canadian Plant *Tycos* Building, Toronto

# *Tycos* Temperature Instruments

**INDICATING - RECORDING - CONTROLLING**

*There's a Tycos or Taylor temperature instrument for every purpose*

# Air-handling calls



*Type "E" Electric Blower*

The selection of equipment for blowing, exhausting, conveying, cooling, drying, heating or tempering air calls for your best judgment, because a slight difference in efficiency, an ever-so-little difference in strength, a trifling increase in horsepower required to drive that equipment may result, over a period of years, in an excessively large difference in cost.

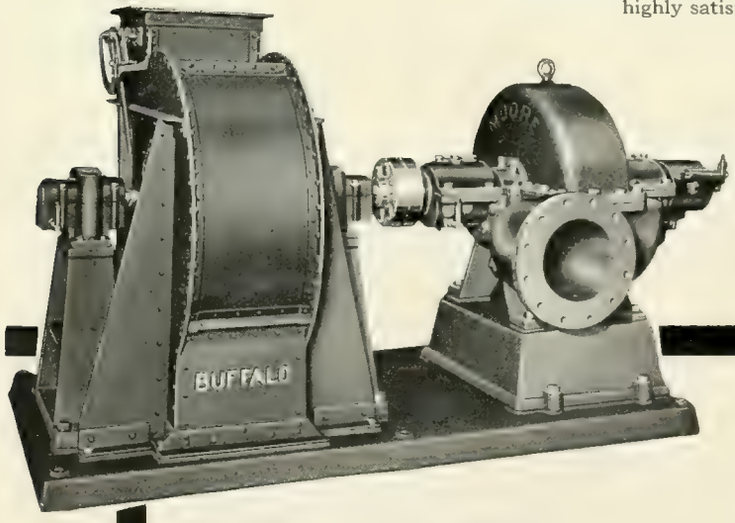
That's why, more and more each year, manufacturers want to know ALL the facts before they buy this type of apparatus, and that also explains the growing preference among the largest users for Buffalo fans.

No matter what your requirements are, there is a Buffalo blower or exhauster to take care of them.

For the thousand-and-one uses requiring a small, comparatively high pressure blower, we have the Type "**E**" illustrated at the upper left. These fans are made in a series of stock sizes with capacities from 50 to 4000 c.f.m. and are chiefly used for blowing forge fires, oil and gas furnaces, removing dust, chips, lint; for deep mine ventilation, etc. The housings are adjustable to any discharge.

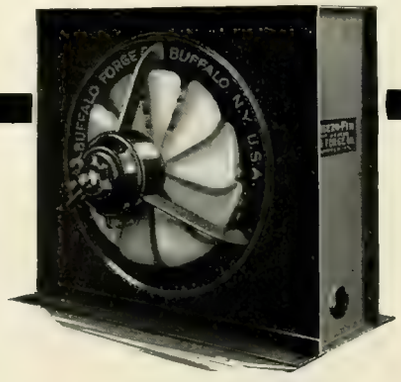
For larger capacity and higher pressure the Type "**R**" fan is a favorite. This is a built-to-order, steel-plate fan, and is made to meet your individual requirements. Used extensively with powdered coal burning outfits and oil and gas furnaces.

For heating shops, warehouses, garages, etc., the Buffalo "Breezo-Fin" heater will be found ideal. This unit is made in four sizes, has enormous capacity, very low operating cost, is easy to install and very low in price! Uses steam coils and Buffalo Breezo electric fan. Hundreds of these heaters are giving highly satisfactory service all over the country.




*Type "R" Steel Plate Pressure Blower*

*Breezo-Fin Unit Heater*




"Buffalo" — equipment for

# for more than "fans"

For ventilating offices, store rooms, basements, garages, etc., the Buffalo Breezo Fan is unexcelled. This fan has ten points of actual superiority that make it an outstanding value. Made in six sizes.

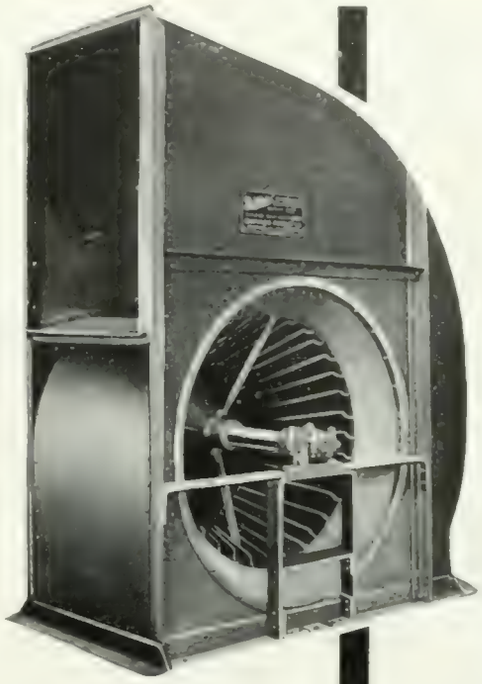
General heating and ventilating apparatus consisting of Buffalo fans and heaters has given universal satisfaction for more than forty years. We can show you statements of users that more than justify all our claims for this equipment.

For mechanical draft work, Buffalo forced and induced draft fans have been so successful that to-day they are used in the largest power plants—such stations as Philo, Columbia Power Station, Hell Gate, Crawford Avenue Station, Calumet, Avon Station, Hudson Avenue Station, and many others—operated by the very largest power companies.

We also manufacture a complete line of industrial exhausters, Buffalo Slow Speed Mill Exhausters, which are guaranteed to save at least 20% in H.P.

Our experience in meeting the requirements of many diversified industries and many unusual conditions entitles us to YOUR consideration when YOU are in the market for any of this equipment.

We'll be glad to send you further information on request.



*Niagara Conoidal Fan*

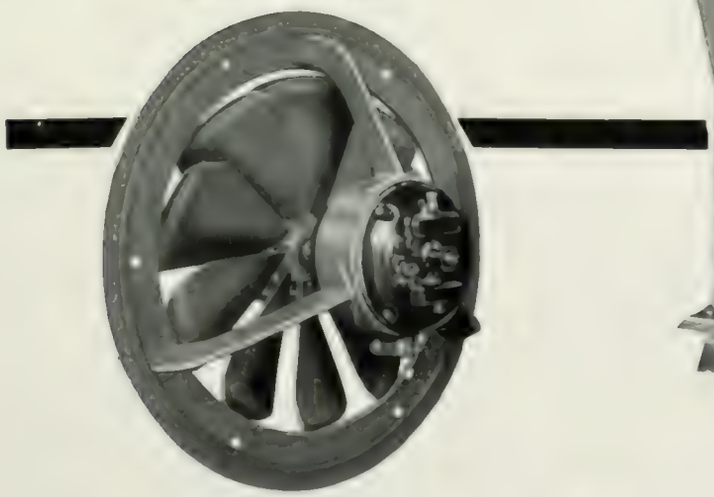
## Buffalo Forge Company

111 Mortimer St. Buffalo, N. Y.

BRANCHES IN ALL PRINCIPAL CITIES

*In Canada*

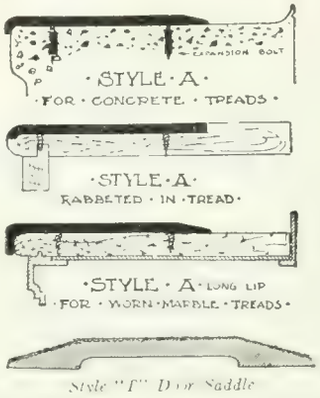
CANADIAN BLOWER & FORGE CO., Ltd.
Kitchener, Ont.



# every Air-Moving service

# Make Walkways Safe

**FERALUN**
*Anti-Slip Treads*



*Style "T" Door Saddle*

It costs less in the end because anti-slip treads with their extremely hard surfaces last as long as your building. A record kept in the New York subways showed that over 14,000,000 people used a certain stairway before the Feralun Anti-Slip treads began to lose their special effectiveness.

At an important railroad terminal 141 accidents occurred in two months on a stairway equipped with new ordinary grooved treads. Feralun treads were substituted and for three months (as long as records were kept) no falls were reported.

You can equip your stairs and walkways, either new or old, with Feralun Anti-Slip Treads and secure this durability and safety at low cost.

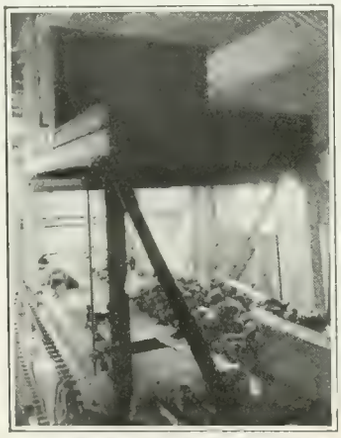
*Send for Complete Information*

**AMERICAN ABRASIVE METALS CO.**
48 Church Street, New York

FERALUN BRONZALUN ALUMALUN CARBORUNDUM TILE

**SAVE TIME AND LABOR**
USE THE
# Merrick Conveyor Weightometer

Any material handled on a belt, bucket or pan conveyor fitted with **MERRICK WEIGHTOMETER** is automatically weighed as it moves along. The scale is always on the job—it makes no slips—it's honest—and its totals at the end of the day are accurate and they require no special attendant.



TYPICAL INSTALLATION

***Material being handled over Weightometers***

| | |
|---|---|
| COAL | FERTILIZER |
| ORES (all kinds) | PHOSPHATES |
| CEMENT | SAND |
| SHALE | PAPER MILL PRODUCTS |
| CLINKER | HOG FUEL |
| ROCK | SALT |
| GYPSUM | ETC., ETC. |
| FISH | |

**MERRICK SCALE MANUFACTURING CO.**
186 AUTUMN STREET, PASSAIC, NEW JERSEY


reinforcing bar division of the Penn Metal Company of Boston.

**Salt's Textile Manufacturing Company.**—A. P. Smith has been appointed receiver. The Bondholders Protective Committee has informed the holders of the first mortgage 15-year 8 per cent sinking fund gold bonds that it will be unable to make the next interest and sinking fund payments both due June 1, 1926. The profit and loss deficit on December 31, 1925, was $3,876,891.

**Savage Arms Company.**—Compared with a net loss of $20,176 in the initial quarter of 1925 the Savage Arms Company reports for the first three months of this year a net profit of $69,526, after depreciation, taxes and other charges. In the fourth quarter of 1925 the company reported a net profit of $92,646.

**Serv-El Corporation.**—Plan for recapitalization of the company has been declared operative and the new corporation organized under the laws of the state of Delaware has succeeded to the properties and business of the Virginia Corporation.

**Shredded Wheat Company.**—Application has been filed with the Secretary of State of New York for an increase of capital stock from 100,000 shares of $100 par value to 400,000 shares of no par value.

**Standard Oil Company of Indiana.**—Employees of the Standard Oil Company of Indiana, numbering 15,722, or 70.87 per cent of the total employees eligible to subscribe to the company's profit sharing plan, own 4.2 per cent of the capital stock.

**Standard Oil Company of New Jersey.**—Policy in regard to vacations has been extended placing factory workers virtually on the same level as office workers. Under the new arrangement employees who have been with the company five years or longer receive two weeks vacation with pay. All employees who have been in service from one year to five years receive one week vacation with pay.

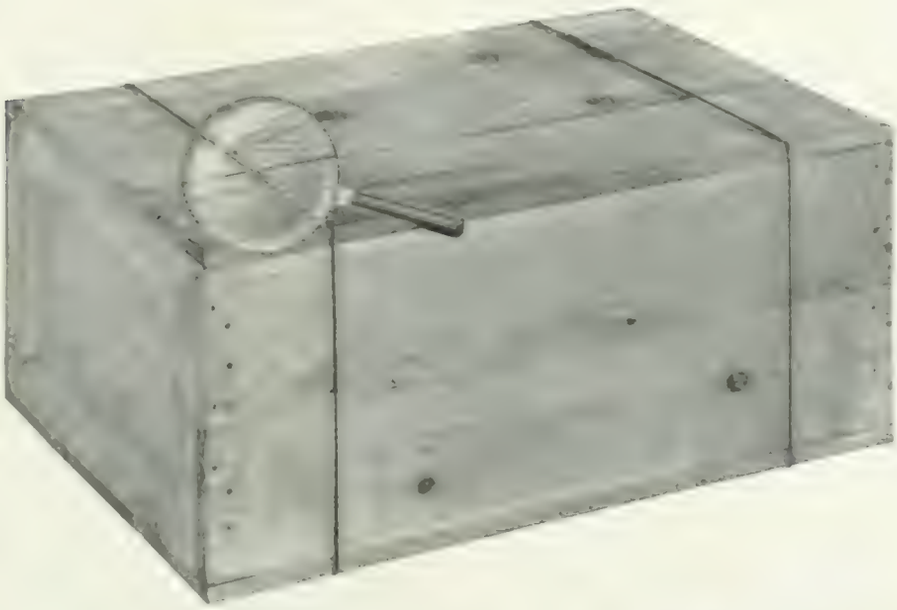
**Stover Manufacturing & Engine Co.**—

| *Calendar Years*— | 1925 | 1924 |
|---|---|---|
| ] Gross profit on sales. | $422,908 | $318,048 |
| Other income. | | |
| Total | $422,908 | $318,048 |
| Selling, gen., &c., exp | 261,570 | 265,926 |
| Interest charges | 4,600 | 17,655 |
| Est. Fed. income tax | 22,099 | |
| Net profit for year. | $134,639 | $34,466 |
| Tot. P. & L. sur. Dec. 31. | $1,120,337 | $1,151,286 |

] After deducting all manufacturing expenses, maintenance, depreciation (of $96,565 in 1925 and $94,997 in 1924), property taxes, &c.

**Tennessee Coal, Iron & Railroad Company.**—The Southern Railway System has awarded contracts for 45,200 tons of thirty-nine-foot 100-pound steel rail for delivery during the latter part of the year. The largest share of the new order, 38,600 tons, was given to the Tennessee Coal, Iron & Railroad Company, which will have the rails fabricated at its Ensley, Ala., plant.

*(Continued on page 476)*



GERRARD
The Tie That Binds

# Gerrard Round Bands of Steel

Gerrard Round Bands of Steel are placed around the shipping container and sealed with the "Tie That Binds" by the Model "G" Little Giant Wire Tying Machine.

Applied under high tension, Gerrard Round Bands of Steel bind the case as if in a vise, adding compactness and solidity to the package and relieving the pull on the nailing.

Such great strength allows users to ship the heaviest materials in cases, which, without being reinforced by the Gerrard Method, reach destination in damaged condition. Lighter and less expensive containers may often be used if they are reenforced the Gerrard way.

Gerrard Round Bands of Steel cost but little to purchase and to apply. Advantages by way of reduction of loss and damage claims and recoopering expense, elimination of pilferage and decreased sales resistance, result from using Gerrard Round Bands of Steel.

Of far greater importance than the money saving is the good will, the business friendship of customers. Why not eliminate one cause for complaint?

*Your copy of the new Gerrard Catalogue contains valuable packaging and shipping information. What is your address?*

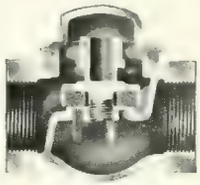
*Invites Theft*

*Easily Opened*

*Gerrard Sealed*

GERRARD WIRE TYING MACHINES CO.
1943 South 52nd Avenue :: :: CHICAGO, ILL.

Fig 152
Screwed, Jenkins Standard Iron Body Angle Check Valve



Sectional view, Fig 117 screwed, Jenkins Standard Bronze Horizontal Check Valve

Fig 352
Screwed, Jenkins Standard Bronze Swing Check Valve.

# Check Valves that check trouble

Install Jenkins Check Valves; their action is prompt and reliable.

The contact at the seat is leakproof, each valve being fitted with a Jenkins Renewable Disc. In addition to insuring perfect contact, a Jenkins Rubber Composition Disc takes up the wear of frequent opening and closing.

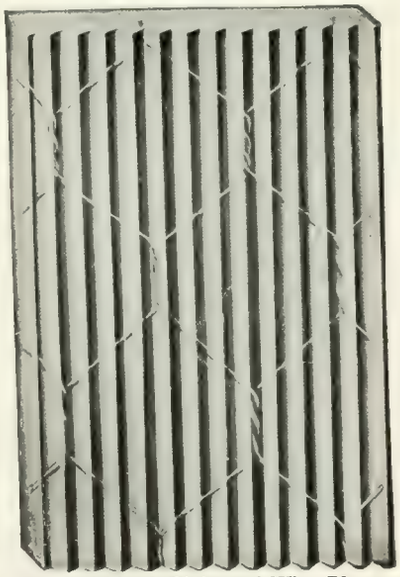
Jenkins Check Valves are made in bronze and in iron, in standard, and extra heavy patterns.

JENKINS BROS.
80 White Street . New York, N. Y
524 Atlantic Avenue Boston, Mass
133 No Seventh Street Philadelphia, Pa
646 Washington Boulevard . Chicago, Ill
JENKINS BROS., Limited
Montreal, Canada London, England

Always marked with the "Diamond"
Jenkins Valves
SINCE 1864



# PENTECOR WIRE GLASS



Made in both Plain and Wire Glass

For skylights, this is the best type of glass to install, because it is scientifically designed especially for skylights to conduct condensation and transmit the maximum amount of daylight.

There is no glass which will give better light distribution in skylights than Pentecor. It is no more expensive than Rough or Ribbed, so why not get the best and reduce the cost of artificial illumination?

MISSISSIPPI GLASS CO.
MISSISSIPPI WIRE GLASS CO.
220 FIFTH AVENUE
CHICAGO, ILL. NEW YORK ST. LOUIS, MO.


**Tide Water Oil Company.**—The Tide Water Sales Corporation, a subsidiary announces the completion of a new distribution plant at Woodbury, near Camden, N. J., in anticipation of expanding business in this territory. Last week the company announced the opening of a new district office in Minneapolis to serve the Northwest. The Woodbury plant consists of a warehouse, one storage tank for lubricating oil, two tanks for gasoline, a garage and office buildings.

**Underwood Typewriter Company.**—Net income of $870,260 after depreciation and Federal taxes is reported for the first quarter by the Underwood Typewriter Company. This compares with a net profit in the corresponding period of 1925 of $1,011,842. The 1926 earnings are equal, after preferred dividends, to $2.05 a share earned on 400,000 shares of common stock outstanding, against $2.38 in 1925. The company retired $100,000 of its 7 per cent cumulative preferred stock during the opening three months of 1926.

**Union Oil Company.**—In association with other California oil companies, the Union Oil Company has started a safety school to minimize accidents in the oil industry.

**United Paperboard Company, Inc.,** has just put into effect a group plan insurance for its employees. The policy covers 765 lives and the amount is $1,502,500. This insurance is on the contributory basis, the workers pay a part of the premiums, the company the remainder.

**United States Gypsum Company.**—The directors on May 12 declared an extra dividend of $1 per share on the common stock, par $20, in addition to the regular quarterly dividends of 1¾ per cent on the preferred stock and 40 cents per share on the common stock. The extra dividend is payable May 31 to holders of record May 22, and the usual quarterly dividends are payable June 30.

**United States Rubber Company** has adopted a group insurance plan for life and permanent disability insurance for its full-time salaried employees. Eighty-five per cent of the 10,164 employees eligible for this insurance have already applied. The amount of insurance for which each is eligible and the weekly cost is given in the following table. The cost to employees is at the rate of 15 cents per week for each $1000 of insurance.

| Salary | Amount of Insurance | Cost to Employee |
|---|---|---|
| $1,000 and under | $500 | $ .08 |
| 1,000 to $1,500 | 1,000 | .15 |
| 1,500 to 2,000 | 1,500 | .23 |
| 2,000 to 3,000 | 2,000 | .30 |
| 3,000 to 4,000 | 3,000 | .45 |
| 4,000 to 5,000 | 4,000 | 60 |
| 5,000 to 7,499 | 5,000 | .75 |
| 7,500 and over | 10,000 | 1.50 |

*(Continued on page 478)*

# Help Your Superintendent

and Accountant
to Check Every Man's

# *Elapsed Time*

GIVE these executives the best facilities possible in order to carry on their work of increasing accuracy and economy!

Superintendents everywhere are definitely checking up the productivity of their men, collectively and individually, at a glance.

Accountants in thousands of plants and factories all over the world are saving money by protecting their books.

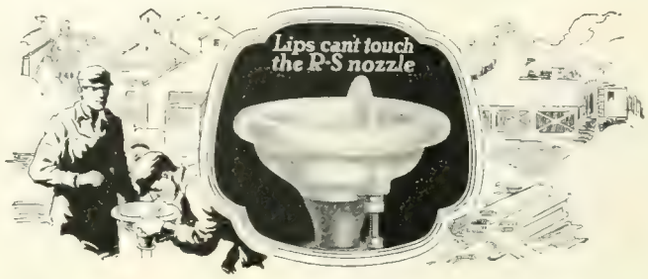
And all this is done with Calculagraph!

There is a big, constructive story behind Calculagraph — and we have told all the facts in our comprehensive booklet — *Elapsed Time Records* — explaining how a Calculagraph prints on any style of time ticket *the exact working time elapsed* for every man—and also the time of beginning and ending every job. Write for a free copy to-day.

The Calculagraph Company
50 Church Street Dept. 12 New York City

# CALCULAGRAPH

*The Elapsed Time Recorder*




## Make Warm Weather Workers

Employees lessen their efforts in the summertime. That's why you should install Rundle-Spence Vertico-Slant Fountains.

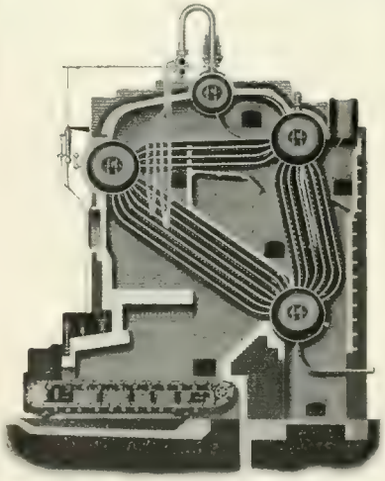
They make warm weather workers, and put the "drive" in production. The clear, cool water refreshes and invigorates. No possibility of drinking contamination because lips can't touch the R-S nozzle. Every one must drink *sanitarily*.

The R-S line includes Sanitary Drinking Fountains, Bath and Plumbing Fixtures and Supplies. Write for catalog with complete information.

RUNDLE-SPENCE MFG. CO.
62 Fourth Street Milwaukee, Wis.

RUNDLE-SPENCE

## Elesco for Vogt Engineering Boilers



Elesco Superheater in a Vogt Bent-Tube Boiler. This arrangement is covered by Bulletin T-10-Vogt. May we send you a copy

In the bent tube boiler, Elesco superheater units extend from outside headers through the upper tube bank and into the free space below when moderate superheat is desired.

For higher superheat the units extend into the lower tube bank where the furnace heat is absorbed both by radiation and convection. A nearly constant temperature is, therefore, maintained irrespective of boiler ratings.

Also for Vogt horizontal boilers, a suitable superheater arrangement is provided.

Whenever the matter of boilers and superheaters comes up, Elesco engineers will gladly co-operate with you.

Advise the make and style of boiler which you have and we will send you a copy of the bulletin on Elesco superheaters applied to this particular construction.

THE SUPERHEATER COMPANY
17 East 42nd Street NEW YORK — Peoples Gas Building CHICAGO
Boston — Pittsburgh
Canada: The Superheater Company, Limited, Montreal


Employees 60 to 64 years of age are eligible for $1000 of insurance. Employees 65 years old or more are eligible for $500.

In event of total permanent disability, resulting from bodily injuries or disease, before the insured employee attains the age of 60, no further premiums are collected and the principal sum is paid to the insured.

**United States Smelting, Refining & Mining Co. (& Subs.)—**

| | 1925 | 1924 |
|---|---|---|
| Net earnings | *$7,989,995 | *$6,902,806 |
| Other income | | |
| Total income | $7,989,995 | $6,902,806 |
| Interest on funded debt | 801,382 | 730,393 |
| Deprec. & reserve funds | 2,785,665 | 2,572,466 |
| Federal taxes and reserves | * | * |
| Additional reserves | 1,500,000 | 1,800,000 |
| Pref. dividends (7%) | 1,702,234 | 1,702,225 |
| Common dividends | 1,097,234 | |
| Balance, surplus | $103,488 | $97,721 |
| Profit and loss | $17,421,005 | $17,317,516 |

* Net earnings after charging cost of production, selling exp., res. for Federal taxes, &c.

**Vacuum Oil Company.**—The directors have declared an extra dividend of 50 cents a share in addition to the regular quarterly dividend of 50 cents a share on the outstanding capital stock, par $25, both payable June 19. Extras of 50 cents per share were paid on March 20, June 20 and Sept. 19, 1925, and on March 20, 1926, and one of $1.50 per share on December 19, 1925. Total distributions including extras, in 1925, amounted to $5 per share, compared with a total of $3.75 per share paid in 1924.

**Wanner Malleable Castings Company.**—The Company reports a loss for the year ended December 31, 1925, before depreciation, interest, amortization of deferred charges and obsolescence, of $98,697, which included drop in value of inventory and work in progress. Total net loss for the year 1925 after all charges was $163,859.

**Ward Baking Corporation, New York.**—The directors have declared an initial dividend of $2 a share on the $8 non-cumulative no-par value class A common stock and the regular quarterly dividend of 1¾ per cent on the preferred stock, both payable July 1.

**Henry Weis Manufacturing Company, Inc.,** has just moved general offices and factory to a new plant in Elkhart, Ind. This location was selected because of nearness to sources of raw materials, excellent shipping facilities and good living conditions for employees. The principal products of the firm are toilet, shower and dressing room compartments, hospital ward and waiting booth cubicles, and steel door frames and trim.

**Western Electric Company, Inc.**—Sales billed for the first quarter this year by the Western Electric Company, Inc., were $57,893,000, as compared with $57,338,000 last year. Orders were $61,057,000, as against $57,881,000. Orders on hand at March 31

(Continued on page 481)

# Straight-Line Production for Westinghouse Irons

STRAIGHT line production, handled by a Mathews Conveyer System, has made possible increased production with greatly lowered handling costs in the plant of the Westinghouse Electric Products Company, at Mansfield, Ohio.

This conveyer system which plays a part in every operation connected with the production of automatic electric irons includes a great variety of types of conveyer.

Sheet metal and cast parts are handled in tote boxes between operations, delivered to stock, and to assembly lines on roller and power conveyer units. The installation also includes spiral floor-to-floor conveyers, specially designed and constructed pallet conveyers, chain conveyers, power elevators, deflector systems, switches, etc.

Any executive interested in getting results for his own plant such as Mathews has made possible for the Westinghouse Electric Products Company will find in Mathews Conveyer Systems the means of getting increased factory turnover with large economies in time and labor.

No matter how complicated your production processes may be, Mathews will help "straight-line" them with quality equipment, built for years of profit-earning service. Call a Mathews engineer for a discussion of your requirements. There's no obligation.

MATHEWS CONVEYER COMPANY, ELLWOOD CITY, PA.

New York, Boston, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Atlanta, Anderson, S. C., New Orleans, Minneapolis, Milwaukee, St. Louis, Omaha, Denver, Salt Lake City, Los Angeles, San Francisco, Seattle. Canadian Factory: Fort Hope, Ont.

# MATHEWS
## *Conveyer Systems*
### *Increase Plant Profits*

Mathews Conveyer Company
Ellwood City, Pennsylvania

You may give me further information on Mathews Conveyer Systems. We are interested in the mechanical handling of .....

You may have your representative call.

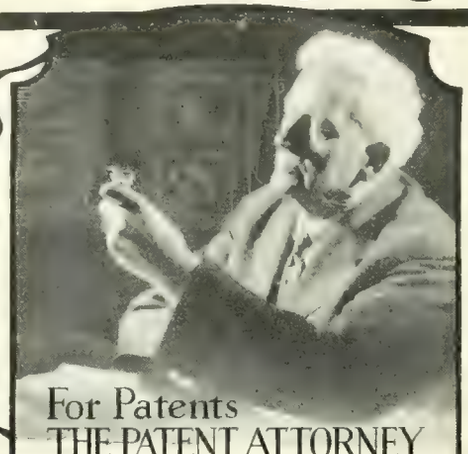
Firm

Individual

Address

MI 6-26

# For Packaging ~ the Package Engineer



## For Patents THE PATENT ATTORNEY

WOULD you attempt, without expert counsel and guidance, to steer a patent application through the complexities and seeming contradictions of patent office practice?

The proper balancing of all the varied and intricate factors entering into the right package design demands a similar breadth of intimate specialized experience.

## He *Knows* Packages

The Bryant Electric Co. of Bridgeport, Connecticut, the world's largest exclusive manufacturers of electric wiring devices, are recent converts to H & D corrugated boxes.

The boxes were adopted after they had proved their worth in experiments conducted with trial packages designed by a Hinde & Dauch Package Engineer.

The result is a cash saving of many thousands of dollars annually in a lower first cost and 40% lighter shipping weight—while big returns are credited to good will in cleaner packages, an almost complete elimination of damage claims and the value of the advertising printed on the box.

Mr. E. G. Thrall, Purchasing Agent, says: "The H & D Package Engineer has given us the most protective fibre box for the least money for our many different products."

SUPERFICIALLY, your shipping package is "just a box." Actually, it is either a sales-maker or a sales-breaker. A money-saver or a source of serious loss.

In which classification it falls depends on a host of contributing factors—upon what your competitors are doing—whether or not you are taking full advantages of shipping privileges—whether it costs you too much in packing labor, space requirements, or damage claims.

*Frankly,* are you prepared to answer such questions definitely and absolutely? Doesn't it stand to reason that an expert, familiar with the latest packaging developments, may show you improvements you never dreamed of?

A staff of 40 such factory-trained, laboratory-schooled package engineers is maintained by the world's largest producer of corrugated fibre shipping boxes and packing materials. An H & D "P. E." will call at your office and serve you to the best of his seasoned ability at no cost or obligation to you. Fill in the coupon.

*The* HINDE & DAUCH PAPER Co.
907 WATER STREET SANDUSKY, OHIO

*Canadian Address,* Toronto:
King Street, Subway and Hanna Avenue

*The World's Largest Producer of Corrugated Fibre Shipping Boxes and Packing Materials.*

THE HINDE & DAUCH PAPER COMPANY
907 Water St., Sandusky, Ohio

Please have a Package Engineer call ☐

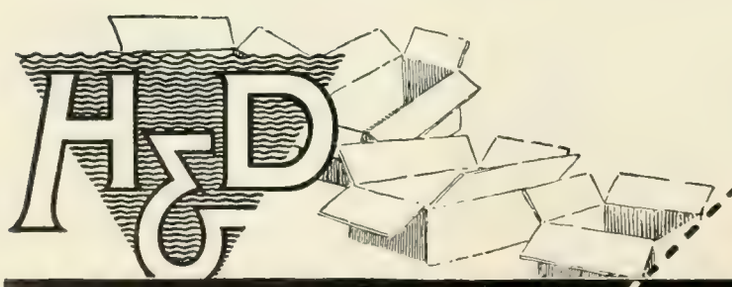
Send me copy of booklet, "*How to Use H & D Free Service.*" . . . . . ☐

*Name of Company* .....

*Name of Writer* .....

*Street Address* .....

*City* ..... *State* .....




CORRUGATED FIBRE SHIPPING BOXES

were $80,208,000 as compared with $87,070,881 in 1925.

**Westinghouse Electric & Manufacturing Company.**—Sales for the year ending March 31, 1926, were the largest in the company's history. The total of all payrolls for the year was $74,144,607, or $40.49 per capita for the 1,831,665 employees.

Value of capital assets at the end of the fiscal year was $55,101,247.

| | |
|---|---|
| Income Account for Year | |
| Gross Earnings | |
| Sales, Etc. | $100,408,861 18 |
| Cost of Sales | |
| Factory and operating expenses, Depreciation, Taxes and Non-operating Expenses, Other Expenses and Depreciation, and Depreciation and Obsolescence on Selling Apparatus, Depreciation on Buildings and Miscellaneous Expenses and Taxes | 71,711,635 78 |
| Net Manufacturing Profits | $ 28,697,225 40 |
| Other Income | |
| Interest, Discount and Miscellaneous Income and Profit on Sale of Stocks and Bonds | $ 809,978 84 |
| Dividends and Interest on Stocks and Bonds Owned | 1,491,284 60 2,301,263 44 |
| Gross Income from all Sources | $ 30,998,221 84 |
| Deductions from Income | |
| Interest on Bonds | 2,108,224 97 |
| Net Income Available for Dividends and Other Purposes | $ 28,122,000 87 |

**Weston Electrical Instrument Corp.**—

| | |
|---|---|
| *Results for Year Ended December 31, 1925* | |
| Earnings after deducting cost of materials, labor, repairs, depreciation, selling and administrative expenses | $791,037 |
| Other deductions less other income | 41,242 |
| Federal income tax | 87,863 |
| Net profit for year | $646,931 |
| Capital and surplus Jan. 1, 1925 | $2,044,391 |
| Additional 50,000 shares common stock issued | 750,000 |
| Total | $3,441,322 |
| Dividends paid on Class A stock | 201,000 |
| Extraordinary charges, net (not applicable to current operations) | 98,290 |
| Balance, represented by 100,000 shares of Class "A" and 150,000 shares of common stock | $3,142,031 |
| *Income Account for Quarter Ended March 31* | |
| Net after depreciation and expenses | $245,461 |
| Other income | 2,055 |
| Total income | $247,516 |
| Federal taxes | 32,257 |
| Class A dividends | 50,000 |
| Surplus | $165,259 |
| Capital and surplus March 31, 1926 | 3,307,390 |

**Willys-Overland Co.**—At the annual meeting, Pres. John N. Willys said:

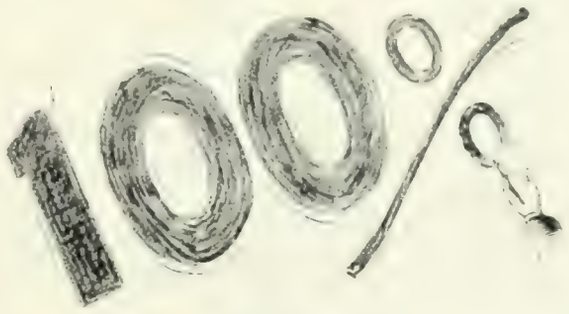
"General conditions warrant great confidence in the automobile industry in general and greater confidence in the future of the company. Earnings for the first four months, after all charges except Federal taxes, were in excess of $3,250,000 or an equivalent of the entire year's dividend requirements on the 7% preferred stock and a balance of 78 cents a share upon the 2,527,000 shares of common stock. Of this total March contributed $1,270,820 and April over $2,000,000.

**Yale & Towne Manufacturing Company.**—

| Quarters ended March 31 | 1926 | 1925 |
|---|---|---|
| Net earnings | $783,185 | $[illegible] |
| Depreciation | [illegible] | [illegible] |
| Federal taxes | [illegible] | [illegible] |
| Net income | $591,332 | $432,788 |
| Dividends | [illegible] | [illegible] |
| Surplus | $[illegible] | $[illegible] |


# Mercury

(This is No. 6 of a series)




**Mercury believes** in the tractor-trailer method.

**Mercury** builds no power unit except the tractor—4 types and 10 models.

**Mercury** is the only tractor manufacturer who makes a full line of trailers to work with the tractor.

**Mercury** sales engineers are tractor-trailer specialists. They know the equipment and how best to apply it.

**Mercury** installations predominate. A little investigation will convince you of this fact.

**Mercury** can—and will—demonstrate a complete installation in your own plant.

*We welcome the opportunity to tell and* **prove** *our story.*

**Mercury Manufacturing Company**
**4124 So. Halsted St.** **Chicago, U. S. A.**

# Tractors and Trailers

# PROFESSIONAL COUNSEL

**WALLACE CLARK**
*Consulting Management Engineer*

Methods that get things done on time, reduce costs and give the executive complete control.

50 West 12th St. NEW YORK
*Full information on request*

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**WALTER N. POLAKOV & CO.**
*Savings in*
INDUSTRIAL POWER
without capital investment
25 Fifth Avenue, New York City

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**Ayres, Scheiter and Tucker**
INDUSTRIAL
ENGINEERS AND ACCOUNTANTS
618 DREXEL BUILDING
PHILADELPHIA, PA.

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## GENERAL MANAGER, WORKS MANAGER or COMPTROLLER

Good organizer and personnel builder. Unusually broad experience for his years. Age 34. Experience covers Organization and Management of Manufacturing, Production, Purchasing, Cost-Finding, and Budget, in the following lines: Interchangeable Small Parts Manufacture, Steel Plants, Sheet Metal Products, Structural Steel, and Woodworking. Desires to share in the profits he increases through cost reduction. Available July 1st. Box 343, MANUFACTURING INDUSTRIES, 15 East 26th Street, New York City.

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## A GENERAL EXECUTIVE

Who has about completed the rehabilitation of an important Manufacturing Industry with diversified products, and possessing a large Branch and Agency Distributing Organization, wishes to offer his services to another Corporation which may desire to utilize his experiences in investigating and improving conditions.

Have met with gratifying success with present and former principals in reducing costs by eliminating leaks, increasing production, reducing inventories of raw material and finished products; consequently adding very materially to the net profits of the Industry.

The results in former and present experiences were obtained by evolving a simple but comprehensive accounting analysis embracing accurate cost data, current material and stock control, and by utilizing these facts and figures in co-operation with the Engineering Staff, the Superintendents and Heads of the various Departments and the Selling Organization in attaining the desired goal.

Some lines of activity investigated consisted of the manufacture and sale of Pulp and Paper, Iron Mining, Smelting, Casting and Machining, the operation of Timber Limits and Saw Mills, Retail distribution by a high grade Chain Store Organization, etc., etc.

Names of present and former principals will be gladly furnished upon request. Age 45. Remuneration according to extent of responsibilities to be undertaken and upon results secured. Box 336, MANUFACTURING INDUSTRIES, 15 East 26th Street, New York City.

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Carle M. Bigelow, M. E. President — Robert W. Kent, B. S. Vice-President — John A. Willard, S. B Treasurer

**BIGELOW, KENT, WILLARD & CO., Inc.**
CONSULTING ENGINEERS AND ACCOUNTANTS
Park Square Building — Boston, Massachusetts
Production—Costs Sales—Audits—Building and Machine Design—Valuations—Chemical and Physical Testing—Industrial Research—Management—Trusteeships—Financing

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ENGINEERS ACCOUNTANTS
347 MADISON AVENUE
NEW YORK CITY

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## STEVENSON, HARRISON & JORDAN

*A Consolidation of*
THE STEVENSON CORPORATION — G. CHARTER HARRISON — J. P. JORDAN AND ASSOCIATES

MANAGEMENT ENGINEERS

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Organization, Measurement and Control of Sales, Production and Costs

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## WANTED—POSITION AS COMPTROLLER

C. P. A. of long banking and financial experience and mature judgment, wishes a position as Comptroller, Treasurer or Auditor in small city or town in one of the Eastern States. At present member of firm of Public Accountants in large Middle Western City. If living conditions are particularly attractive salary will not be all important. Box 341, MANUFACTURING INDUSTRIES, 15 East 26th Street, New York City.

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## OFFICE MANAGER

of a well-known Massachusetts corporation experienced in cost and production methods, credits and collections and corporation finance, desires connection with a corporation offering an opportunity of becoming a member of the firm. Box 342, MANUFACTURING INDUSTRIES, 15 East 26th St., New York City.

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## EXECUTIVE MANAGER WANTED

A large corporation is seeking a high grade, technically trained executive who knows engineering and production from all angles and who is familiar with the higher executive duties of general management. The position calls for a real progressive, around 40 years old, who has rapidly climbed to large responsibilities with a constructive record of achievement along the most modern business lines. Full details, with photograph, are desired. Box 340, MANUFACTURING INDUSTRIES, 15 East 26th Street, New York City.

# Dependable Refrigeration

Perfect, continuous operation! Freedom from mechanical defects! Your time saved as well as your money! Lipman Refrigerating Machines may cost a little more than some. That extra expense has gone into the machines, making them stronger, surer, in every way *more dependable.*

Ice carries with it an uncertain cold and unceasing bother. It is unsanitary and untidy. Lipman Refrigerating Machines produce cold in an orderly, controllable way. They may be depended upon to save time and money by giving steady, attention-free service.

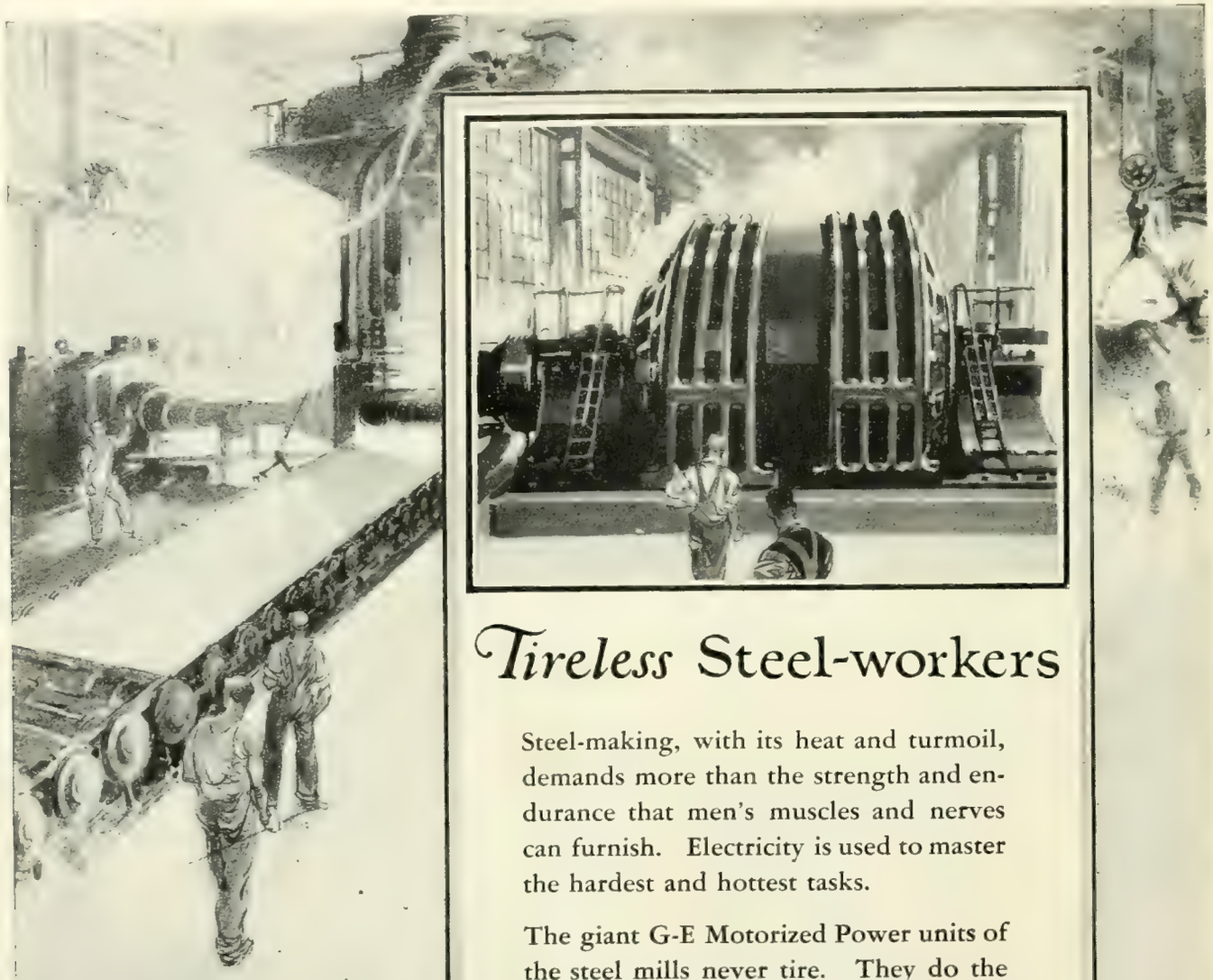
*Sales and Service Stations all over the United States assure dependable service to Lipman owners.*

## General Refrigeration Company

132-194 Shirland Ave. Beloit, Wisconsin

GR CO.

THE DRY, CONSTANT COLD OF THE MOUNTAIN TOP



# *Tireless* Steel-workers

Steel-making, with its heat and turmoil, demands more than the strength and endurance that men's muscles and nerves can furnish. Electricity is used to master the hardest and hottest tasks.

The giant G-E Motorized Power units of the steel mills never tire. They do the work of many men in the roaring heat of the rolling mills. In the yard, with G-E Motorized Power, two men unload as much pig iron as 128 men could move by hand. At the furnace-charger one operator does the work of 40 men.

So here, as in the other basic industries, G-E Motorized Power cuts the cost of production, raises the productive value of workmen and helps to maintain the high standards of American industry.

G-E Motorized Power is more than a motor or its control—it is a practical and economical application of electric power. "Built-in" or connected to all types of industrial machines or household appliances, G-E Motorized Power provides lasting assurance that you have purchased the best.

**MOTORIZED POWER**
*-fitted to every need*

# GENERAL ELECTRIC

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